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THE PROCEEDINGS

OF THE

UNITED STATES NAVAL INSTITUTE.

Vol. XXVIII., No. 2. June, 1902. Whole No. 102.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE DEFENSE OF OUR NEW NAVAL STATIONS.

By CAPTAIN DION WILLIAMS, U. S. Marine Corps.

Four years ago the territory of the United States was entirely contained in the continental limits of North America. The ships of our fleet were tied to our home ports by the invisible, but none the less binding, ties of their steaming radii.

Despite the earnest pleadings of the officers of the Naval Service, and of a few farseeing statesmen for the acquisition of stations where the coal which is the very life's blood of the modern man-of-war might be stored against the day of need, not one foot of outlying territory had been acquired; and we of the service were forced to the realization that in case of war our fleet must stay close by the home ports or depend upon the aid of colliers, the doubtful help of friendly neutrals, or upon captures from the enemy, for the coal to feed our engines of war.

The colliers would perforce be used upon every occasion for distant service, but once their supply was exhausted it would mean a long voyage to a home port in the United States to replenish the supply, and at best, under the convoy of fighting ships which would always be needed on the first line.

To rely upon the help of friendly neutrals in time of war is putting trust in a possibility, scarcely in a probability, especially for a nation which has as a basic principle, "entangling alliances with none."

To rely upon the probability of capturing a coal supply from an aggressive enemy would be a fine example of the proverbial "counting of one's chickens before they were hatched," for not until the enemy's fleet had been defeated and the batteries of his arsenals forced and silenced, could we hope to live upon his stores, and that time would be at the end of the campaign.

To acquire and fit out coaling stations in times of peace, well situated as to the probable theatre of future operations in time of war, naturally presents itself as the solution of the problem.

At these stations our squadrons could rendezvous for the first dash against the enemy and fill their bunkers and magazines, and to these stations the colliers could return for a new supply for the ships on the first line, while disabled ships could use them as harbors of refuge while repairing and refitting.

It seems to be well established that the debatable ground of the future is to be found on the shores of the Caribbean Sea and in the Far East, where governments are still unsettled and unsatisfactory, and the avarice of the land hungering nations may at any moment lead to a war that would involve us on the one hand to uphold the Monroe Doctrine, and on the other to prevent the partition of China and the consequent loss to our commerce.

The late Spanish War, fought primarily to free Cuba from the irksome rule of Spain, gave us as the dearly bought spoils of war, Puerto Rico and naval stations in Cuba from which to guard the Caribbean, the Philippines as a firm base in the Far East, and indirectly the Hawaiian Islands, and the Isle of Guam as way stations on the highroad of the Pacific; while diplomacy, awakened by the needs brought out in that war, have led to the acquisition of Pago Pago and will doubtless gain for us the Danish West Indies.

In the piping times of peace these islands which have come to us within the last four years will doubtless render millions of dollars commercially; but it is not in commerce that they will best serve the homeland of their adoption. When war

comes and some foreign power, impatient of our great commercial success in the markets of the world, attempts to wrest this supremacy from us, these islands of the eastern and western tropic seas will be worth their weight in gold to us as naval bases back of the first line of fighting ships.

Never was truer word said than that we must "in time of peace prepare for war," for when war comes it is too late, and preparedness has averted more wars than diplomacy. To prepare these island possessions so that they may best serve the country's naval needs in peace and war there must be coal piles at all the best harbors and repair stations at the key points.

One of our greatest generals once said that where he gave one thought to the enemy in front he gave two to his lines of communication with his base in the rear, and this would be just as true of our commanders at sea, for coal and ammunition they must have without stint to hunt down the enemy and defeat him, and everything that can be done to make these bases secure from the attacks of the enemy will tend to lighten the load of care and responsibility that the Admiral at the front must carry, and give him that much more time and energy to devote to the enemy in front of him.

The base stations might be defended by a fleet of battleships had we ships without number, but shore batteries and mines will do it better and cheaper and release the battleships to join the active fleet in operations of an offensive nature against the enemy.

The war of the future between the United States and any foreign power is to be principally a naval war—this is accepted as almost an axiom. The stations on the outlying island possessions should be naval stations and nothing more or less, for their province in war will be to furnish coal, ammunition and supplies for the fighting ships in front of them, and as long as they succeed in this mission the Navy will add new victories to the long list which is our legacy from the glorious past. Hence it is a natural corollary of our axiom that they should be entirely controlled by the Navy, and not as in the case of the forts and shore stations of the continental territory, by the Army.

A large standing purely military force is not at present needed in any of our island possessions except the Philippines,

and the necessity will disappear there when the present conflict with the insurgents is ended. To perform the purely military duties in these islands native troops with white officers would prove as efficacious, and vastly cheaper in lives and treasure, than white troops sent out from the United States. This has been the result of British experience extending over many years in India, and we can avail ourselves of their wealth of experience without spending years of time, millions of dollars, and thousands of lives in experimenting.

Already in our own experience we have found that the Puerto Ricans make excellent infantry soldiers if commanded and drilled by capable white officers, and the same may be said of the native troops who, under the leadership of courageous white officers, have done most valuable service in the Philippines during the last three years. These natives are anxious to become soldiers in our service, are much cheaper in pay and rations, and are already acclimated to the trying tropical conditions.

The guards, however, which are to defend our naval stations and bases in these islands, must be of a more intelligent personnel, for they must be capable of manning the guns of the harbor defenses, controlling and working the intricate mechanism of submarine mines and both automobile and dirigible torpedoes, and in addition should be well enough versed in sea life to serve in the ships of the fleet should occasion arise due to losses in the ships' complements or other causes.

The Marine Corps by its traditions, training and position as the soldiery of the sea, is most eminently fitted to furnish these garrisons. As the possession of outlying naval stations and coal depots is new to the Navy so would the defense of these stations be new to the Marine Corps, but as the development of the stations goes forward so should the training of the marines for the new duties go forward, therefore this fact of lack of familiarity with the duties could not be used against the marines in the face of many excellent reasons why they should perform this duty.

Furthermore, as these stations will be for the almost sole purpose of bases for the fleet, where its coal, ammunition and stores may be held safe from the raids of an aggressive enemy and yet ever ready for instant use by our own ships, they must be directly under the control and at the command of the Commander-in-Chief of the fleet.

Above all there should be no friction between the Admiral afloat and the guardians of his naval bases ashore, such as would most certainly arise were these bases defended by the artillery and infantry of the Army.

It is of the greatest importance that one department of the Government should administer all the affairs of the coördinate branches of the Navy both afloat and ashore, for a division of control would lead to a multiplication of detail and "red tape" in time of peace, and to a fatal lack of cohesion and responsibility under the strain of actual war. Long experience has shown that the so-called co-operation of the Navy and Army in a campaign is a myth, and that neither will subordinate itself to the other, each having its own work to do in its own way.

To place all the defenses of the distant naval stations including the coast defense vessels, torpedo boats, mines, torpedoes and shore batteries under the control of the Navy for whose sole uses they are designed and kept up, will not be to take from the Army any of its legitimate duties, which are many and important.

In an aggressive campaign against an enemy overseas the work of the Army comes after the Navy has gained the mastery of the sea, and captured or destroyed the fleet of the enemy, for not until then can the transports safely take the sea.

In the primary and purely naval stage of the war the coaling and repair stations will play a very important rôle, for without them it will be well nigh impossible for the fleet to keep the sea in readiness to fight or chase the enemy, and for this part of the war these stations will form as much an integral part of the Navy as the battleships on the high seas, and in their humble way just as important a part.

To put the batteries and torpedo defenses of the coaling and repair stations of the Navy under the control of the artillery of the Army would be about as reasonable as to put the batteries of the ships under their control, barring the effects of seasickness, and neither could be justified by sound argument.

If the Admiral who flies his flag at sea must command the guns of his battleships, then just as truly must he command the guns that protect his stores of coal and ammunition from the cruisers of the enemy, for once these stores were captured the campaign would be lost.

In the event of an enemy making the first attack upon our own shores, the Navy's part would be to ward off that attack, to intercept and fight his fleet, and as long as the Navy held the seas beyond our shores no army of the enemy could land thereon, and not until such a landing of the enemy was made or attempted would the real work of the Army begin.

In such a defensive naval campaign the outlying coaling stations would play a leading part; our own ships scouring the seas in search of the enemy would need frequent replenishing of coal and supplies, and the time saved in having it near at hand at the island stations might be the turning point of the contest. Again, these stations, being so important to our fleet, would be the objects of especial attacks from the fast cruisers of the enemy, and should be most ably defended by a distinctly naval force and ever ready to cooperate in an intelligent manner with the fleet, so that they might best supplement its every effort to hold back and defeat the adversary's fleet.

Such intelligent and efficient co-operation could only be secured in a strictly naval war of this character by placing the defenses of the coaling stations entirely under the control of the naval authorities and directly at the command of the Commander-in-Chief of the fleet.

The land defense of these stations would probably be assisted by such harbor defense vessels as might be available, by the small torpedo boats which could not keep the sea with the fleet in all kinds of weather, and by the extemporized war vessel and converted merchantmen used as scouts, supply and store ships. To make the defenders homogeneous and easily and quickly handled in unison they must all be of one service, and since the reason for the very existence of the coaling and outlying stations is purely a naval one, and the personnel of the coast defense vessels and torpedo boats and scouts must in any event be of the Navy, the men who man the shore batteries and works must also be of the Navy if we are to hope for good results.

To detail sailors from the fleet to man the shore batteries would be out of the question, for when war comes every available naval seaman in the country both in and out of the service will be needed at once to man the fighting ships, and all the sailors of the merchant service could be utilized in the auxiliaries, the colliers, refrigerators, and repair and supply vessels

to be called into the service from the merchant fleet of the country.

The Navy has in the Marine Corps an efficient and very mobile force, ever kept at a high state of discipline, and especially fitted for the service of garrisoning our naval bases, because it is one of the component parts of the Navy, trained to the naval requirements and duties, and could be readily adapted to such service by a system of drills and instructions having this end in view.

Such a force garrisoning the coaling stations could be easily reinforced from the guards of the battleships if the occasion arose at any time during active service, and in a like manner the guards of the fighting ships could be filled up from the shore force if undue losses or other causes should make such a transfer advisable, an advantage which would never obtain were the Army forces to man these batteries.

The only value in these distant outlying stations in time of war will be as naval bases, for in the event of an invasion of the enemy's country by our own armies, the mobilization of such armies would best be made at the home ports, ready to sail in a fleet of transports only after the Navy had cleared the sea of all the ships of the enemy, or safely blockaded them in their home ports. In fact, except for the great necessity to successful naval operations, the possession of territory outside of the continental limits of the United States is a positive weakness to our country from a military standpoint; yet the necessity is so great to the success of the Navy in a war with any foreign power that all the disadvantages and expense of maintaining these distant islands are overbalanced.

While this naval stage of the campaign is going forward, the presence of detachments of Army troops, since they would not be under the control of the Navy Department, would be of no value to the naval Commander-in-Chief, and in fact, might prove a serious drawback if it were necessary to detach ships to aid them, especially at points of no importance to the naval defense.

The presence of bodies of naval troops (i. e.—marines) at the coaling stations would however insure just that measure of protection which the Admiral in command might deem most advisable at any stage of the operations, since they would be

entirely under his command and could be used and moved from point to point without asking "by your leave" of the War Department, and in addition they could be used on board the ships of the fleet at any time such detail might be advisable.

At any time during the course of a naval campaign it may become necessary to establish temporary bases upon our own or the enemy's territory. This would be accomplished by anchoring the colliers and supply ships in a convenient harbor and landing a force of marines for its defense, with such great guns of lesser calibres as could best be spared from the fleet, with torpedo boats and light cruisers to aid them. Such defense would be necessary against the cruisers of the enemy, as he would scarcely detach the heavy ships of his fleet for this work.

These particular operations so closely akin to the defense of the naval bases and coaling stations at the permanent points established before the outbreak of the war, could not be done at all by the Army, and yet the one is no more distinctly naval than the other. With such a possibility foreseen before the sailing of the fleet from a home port or large outlying naval base garrisoned by a good sized marine detachment, a sufficient force of the marines to hold the contemplated temporary base could be shipped and easily distributed among the ships of the fleet without disturbing the regular routine, while this could not be done with troops from the Army without much delay and confusion, and the conflict of understanding sure to arise from mixing the two services.

In the same manner at any time it might become necessary to hold a captured port of the enemy with a land force under the protection and support of the guns of the fleet, either as a base of further operations or to await the arrival of an army of occupation. For this duty the marines of the fleet reinforced by those from the nearest coaling station would be of the greatest value, entirely under the command of the Admiral, and giving no opportunity for friction and the delay which would surely arise were the naval bases, batteries and defenses manned by the Army.

When the Nicaragua Canal is built, as built it must be if wisdom in statecraft prevail, it must be protected in any war waged by us or against us, especially should the attack come from both the Atlantic and the Pacific. It seems to be the

accepted idea of the lawmakers that there must be no permanent shore fortifications for this protection, and hence the protection must be had from the guns of the Navy on fleets near either entrance as the circumstances may require.

For a fleet to operate here as elsewhere it must have a good sized coal pile at a convenient base, and if the treaties will not let us prepare the base in peacetime then we must do it at the first outbreak of war. This protection of the canal will be most distinctly the especial work of the Navy, and to guard its bases at the terminal harbors will properly be the duty of the Marine Corps.

In the West Indies coaling stations will soon be established in Puerto Rico, Cuba and the Danish Islands, and if they are to fulfill their purpose as naval bases in time of war, they must be defended by permanent shore batteries and mines ready to be laid according to prearranged plans.

A foreign attack upon these islands would be for the sole purpose of capturing the naval bases and thus forcing our fleet to fall back upon the ports of the mainland, and it would necessarily be a naval attack. The Navy must meet this attack alone, as there is no reason for the Army to even take part in this, the first stage of the war, for if our own fleet is successful in warding off the enemy and in holding the coaling stations, his army will never land upon our soil; while if the fleet fails and is defeated, troops in the islands will not only be useless for home defense just at the time when most needed there, but entirely cut off from communication with home and at the mercy of the victorious ships of the enemy.

In the Hawaiian Islands the conditions are still more favorable to an entirely naval defense. The people are quiet and law abiding, and it is scarcely within the bounds of possibility that an armed revolt will ever occur against the Government, and that would be the only occasion upon which the active services of an army would ever be required.

No army of any enemy could land there while our fleet in the Pacific was still afloat, and after the possible destruction of our fleet the islands would cease to be worth holding even were it possible for a land force to do so, since their sole value in war would be as a naval base in mid-Pacific on the road to the Philippines and the Far East.

The same is true of Guam and, for the South Pacific, equally true of Pago Pago. In the Philippines we will need many coaling stations, and as an important integral part of the naval defense they must be manned by the marines, leaving to the Army there its legitimate duties in connection with war on the land, viz:—the preservation of order among the inhabitants, the control of the native army, and the manning of the forts which are not part and parcel of the naval defense, as are the coaling stations and repair yards.

There is another minor part of the subject which calls for attention here: since our beginning as a nation it has been the peculiar duty of the Navy to uphold the dignity of the country abroad and to protect the American citizen in foreign lands whenever necessary in times of war or disorder. Again and again in the Far East, in Japan, Corea and along the China coast, landing parties of marines and sailors have protected our legations and consulates, as it was and is eminently their duty to do; yet to-day we have in Pekin a detachment of the Army guarding our legation with its nearest army support a thousand miles away.

The ships of the China squadron are ever within easy reach, however, and could at any time furnish the support necessary, and for this reason, if for no other, the guard at Pekin should come from the Navy and be composed of marines. They have proved their fitness for the work by the heroic defense of the legation during the trying summer of 1900.

To perform all of these new and most important duties will require a large increase in the Marine Corps, in line with the large general increase that is necessary for the whole Navy.

To gain the additional number required for shore duty at the coaling stations and naval bases throughout the world, it would not be wise to reduce the number at sea; first, because the Navy needs the marine at sea and in his proper sphere aboard ship there is work for him to do; second, because the marine needs the service at sea, needs the knowledge gained there in gunnery, torpedoes, naval training and seamanship, and above all needs the life at sea to develop that grand service esprit which is our proud heritage from the days of Paul Jones, that close unity of feeling and purpose with the Navy that makes every officer and man of the Marine Corps feel that he

is an important integral part of the Navy with his own work in the field cut out for him.

This increase called for by the new conditions that confront us should not be by great numbers and spasmodically, but preferably by a healthy annual growth until the total number required to garrison all the naval stations in the islands, furnish the necessary complements for the ships, and have a sufficient reserve at the home stations, is reached.

After discussing this question of yearly increase and ultimate strength with the officers of the Navy and Marine Corps, it appears that an annual increase of twelve hundred enlisted men with the proportionate number of officers of all grades, to be continued until a total strength of fifteen thousand is reached, would be a conservative estimate.

There must be men enough to garrison all the outlying stations on a war footing, the more remote stations of course having the larger garrisons due to the increased difficulty in reenforcing them in the event of war, while all the stations should have enough men at all times to make them secure against attack that might come from an active and aggressive enemy at the very first of a war.

At all times there should be a sufficient force at the home stations to give a reasonable relief to the outlying points and to afford opportunity for recruiting and training so that only men ready for the duty would be sent aboard ship and to the islands.

Having these conditions in view, the following is suggested as a reasonable distribution of the force after it shall have reached the full strength of 15,000.

Home stations at the Navy Yards in the United States and for recruiting, training and reserve	5,000
At sea	3,500
At ten stations in the Philippine Islands	3,000
At three stations in the Hawaiian Islands	1,000
At four stations in Cuba	1,000
At two stations in Puerto Rico	500
At two stations in the Danish West Indies	500
One station at Isle of Guam	300
One station at Pago Pago	200
Total	15,000

This would require at the present ratio, which is quite reasonable, the following line officers:

Major General	1	Captains	150
Brigadier Generals	4	First Lieutenants	150
Colonels	12	Second Lieutenants	150
Lieutenant Colonels	12		
Majors	36	Total	515

Considering the technical nature of these new duties of the Marine Corps of the future, all of the officers should come from the Naval Academy, as otherwise years must be spent in teaching officers that which they should know before being commissioned, while the non-commissioned officers and men would have to await the schooling of their company officers before they could receive the instruction from their company officers.

Laying aside that sentiment which is bound to affect the Naval Academy man in his consideration of the question, and considering it as a business proposition alone, the gain by commissioning the officers from the Naval Academy instead of from civil life would be four years in time and vastly more in the esprit and disciplinary training of the Academy.

Considering the fitting of the enlisted personnel for the new duties, better pay for the higher grades of the non-commissioned officers would be necessary, since electrical experts and well instructed ordnance men could not be kept in the service on the present pay, which is so much lower than the pay of corresponding grades in the Navy. Higher pay for the grade of Gunnery Sergeant and raising the standard of the requirements for that grade would easily solve that part of the question however. I can not better illustrate the necessity of this higher pay than by calling attention to the fact that the services of our non-commissioned officers, upon their discharge from the service with excellent records, are eagerly sought by the police forces of the large cities and by elevated and street railway companies at from three to five times their pay in the service; especially is this true at Boston, Mass., the station with which I am at present most familiar.

To properly fit the Marine Corps for these new and important duties a special course of drills and instruction for officers and men must be inaugurated and carried out in addition to the training already given the marine both afloat and ashore.

Such a course would embrace theoretical and practical ordnance and gunnery, fortification works, mines and countermining, and torpedoes, with a theoretical and practical course in electricity incident to the work in planting and controlling mines, using searchlights and establishing telegraph and telephone lines.

As the naval officer of the future must be navigator, sailor, engineer, electrician and ordnance expert, so must the marine officer of the future be infantryman, artilleryman, field engineer and electrician, with some working knowledge of the sea, if the marine is to fill the place that opens out to him in the present scheme for the naval defense of the country. The day has passed when the marine was light infantryman alone, and though the Navy still needs him to some considerable extent in that capacity, the other duties have become more important, and he must be fitted to perform them or lose the greatest opportunity in his history.

A large percentage of the present junior officers of the Corps, coming from civil life and the ranks without the advantage of such a technical education as the Naval Academy gives its graduates, are unfitted at present to perform these new duties, but with constant and well organized study and a weeding out of poor material most of them would meet the requirements in a few years.

At every station schools should be established for the officers and non-commissioned officers with daily instruction in the branches necessary to fit them to build, equip and man the fortifications of the coaling stations and to plant and control the mines that are to protect these harbors of refuge throughout the world. To secure the best results from these post schools the course of study should be the same for all and with the same end in view, and to best fit in with present conditions should emanate from the School of Application at the Headquarters in Washington.

From the post schools those who show most interest and make the best progress might go to this Headquarters School of Application for a higher general course, to the Washington Navy Yard, for Ordnance instruction, to Newport for Torpedo and Electrical instruction, and from all the officers thus taught the most advanced should be given the great advantages of the War College course.

Those who fail to show an interest commensurate with the importance of this work, and who do not make satisfactory progress, should be dropped out to make room for better material, for only the best will meet the new requirements.

This work of instruction has already been begun, but it must be extended to the whole service and carried forward with system and uniformity to obtain satisfactory results, and the time is ripe for such extension.

The question of the relative cost of maintaining the defenses of the naval bases with marines or with the Army has not been considered in this article since it is believed that excellence and not cost should be the standard where the defense of our country is involved.

Yet for the benefit of the commercial man to whom cost is ever an important factor, it may be stated that for many reasons the marine would prove cheaper than the Army soldier for these garrisons. The Marine Corps is conducted upon more economical lines than is the Army, and it is always less expensive both in money and time to have all the different units of defense under one head, which would not be the case were the Army to hold the batteries and the Navy the mine fields and harbor defense vessels. Then again, the question of transportation which would be very simple for the Navy with marines at the garrisons, would under the Army occupation be complicated by the presence of a transport system not under the control of the naval Commander-in-Chief and yet requiring his protection.

Within the limits of this article it is not possible to make an exhaustive study of the subject, nor is it practicable to do more than suggest the means by which the Marine Corps is to be fitted for this important new work. Yet if this article should be the means of starting a general discussion of the subject by abler minds, and of awakening among marine officers an interest in the study that will fit us for these new duties, the writer will feel that he has to some extent fulfilled the wishes of the Board of Control of the Naval Institute, who have done him the honor to request his views on this subject, and that his humble efforts for the good of the Navy in general and of the Marine Corps in particular have not been in vain.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE SCHOOL OF THE OFFICER.

By LIEUTENANT-COMMANDER JOHN HOOD, U. S. Navy.

It is reported that on one occasion the great Napoleon in answering one of his officers, who was attempting to excuse himself for the poor work of his command by claiming that the regiment was poor, replied, "There are *no* poor regiments, but often poor colonels."

Whether the words are correctly quoted, or whether the great conqueror ever really used them or not is immaterial, and in no way affect the great military truth contained in them. In any given nation, a thousand men taken at random will average up in intelligence, courage and patriotism very much the same. Put this thousand in the hands of a skilful leader, and anything of which human nature is capable may be expected of them. Put the same men under the control of another who may even have equal physical courage, but who is lacking in skill and knowledge of his profession, who is dilatory when he should be prompt or vacillating when he should be firm, and nothing but confusion, failure and defeat can possibly follow. In brief, the meaning of the remark quoted—that as the leaders are, so will the followers be—is a great truth applicable to enterprises of any kind, but more especially to those of a military nature.

In a military or naval service educate and train the leaders—the officers—to what they should be, and all the rest that makes for efficiency and success will follow of itself. Fail to so educate them, and our more enterprising and active rivals—who may some day be our enemies—will outstrip us, with the result that in some war of the future we will meet with a defeat and humiliation hitherto unknown in our annals.

Up to the present time the history of the Navy has been all glory, from the isolated battles of revolutionary days down to the recent somewhat opera-bouffe war with Spain. But our next war—and it will come sooner or later, for man, singly or in nations, is a fighting animal and much the same in all ages—will not be with Spain, and we will be put to a proof that has never before been known. With the constantly increasing battle fleets of the great powers of the world, that war will be on a scale to which anything we have hitherto done, will be as child's play to a battle of giants. The contest will be between fleets of the yet untried battleships of to-day, and the victory will be with the fleet whose officers are best trained and educated in the use and capabilities of the mighty engines of destruction placed in their hands.

Are the officers of the Navy to-day, as a whole, as well trained as they are capable of being? Have the authorities that govern us used the best means and efforts in their power to so train them?

It is the conviction of the writer that each of these two questions must be answered in the negative, and it is to suggest a few things that might be done with great improvement to the service that these remarks are written.

The title given this paper is "The School of the Officer," and that school is the ship in active service. The Naval Academy educates but does not train, and only prepares the young officer for his real school. The *training* comes afterwards in the true school for officers—the ship, of which the grades are the ship single, the ship in squadron and the battleship in squadron. The work of the Academy while limited is all that it could or should be, and is perhaps, unequalled by any institution of its kind in the world. That work, however, is educational and preparatory only. The making of the officer comes later, and it is there that it would seem that much more might be accomplished than has been heretofore.

Before offering any suggestions as to what changes in our methods might be made with much improvement to present conditions, a few remarks will be made to show why the changes are necessary, and where the present system and those responsible for it would seem to have failed.

There will be found on almost any of our ships in commission

to-day, officers—and not always the youngest ones—who if ordered to dock or maneuvre their ship in close quarters, would be appalled, and would turn over the responsibility to the captain or executive officer with a sigh of relief. It may also be safely stated that there are few officers in the Navy, of even very moderate lengths of service, who have not at some time in their career seen even the commanding officer turn over the responsibility of handling his ship to a pilot with the same sigh of relief, and this in harbors and channels not especially difficult to navigate. A system that admits of such conditions is surely faulty somewhere, and encouragement should be given to any effort to locate the fault and to remove it.

A study of all the conditions involved in this case shows that the fault lies partly in following a system in which an officer may pass life without ever having been allowed to give the order "starboard" or "port" of his own volition, and partly in a misconception of the relative importance of things on the part of the authorities. So long as the denting of a sideplate on a dockage or the grounding of a ship in a channel way is held by the authorities as something approaching crime, just so long will men made timid by lack of practical experience in youth be yet more timid when called on in mature life to shoulder responsibilities with courtmartial hanging over their heads for matters of little true moment. The occasional grounding of a ship—except where manifest ignorance and incompetence are displayed—is a trivial matter, even though the repair bill be large, when compared to the practical experience that would be gained by the men who must handle our ships in war, if they were required and did handle them at any and all times and under all conditions that were not evidently fool-hardy.

It must be remembered that in time of war we cannot trust to pilots on an enemy's coast to relieve our commanding officers, nor are the lives of these latter invulnerable; and at any time in battle those in command may be killed and any officer may be suddenly called on to command, handle and fight his ship. It may be safely stated that men who are shy of land in time of peace, with all aids to navigation down, will hardly approach an enemy's coast, from which all aids have been removed, with very much of that confidence and boldness necessary to successful offensive action; nor will men who have never been trusted to

put their ships through the simplest maneuvres unaided be very competent to succeed to command in battle.

Turning now to another side of the same question of want of practical experience in our officers—and the lack of confidence in themselves springing from that want—it is probable that if any one of our commissioned ships were selected at random, and the officers questioned, few of them could tell exactly what the tactical diameter of their ship was, what her advance, if a twin screw, what they would be with the inner screw backed, in what distance their ship could be stopped, whether with their ship another vessel or shoal could be better avoided by backing or turning or both, in what time and what way a man overboard could be quickest picked up, and many other like questions, all of which involve the safety of the vessel and lives of the crew in time of peace, and a knowledge of most of which is of vital importance in time of battle. In other words, the officers of the Navy are not, as a whole, trained to *know* their ships and their ships' capabilities either as they should or could be.

That this criticism is deserved will probably be substantiated by almost any officer who has witnessed our infrequent squadron maneuvres, and the fault lies not with the officers themselves—for they are individually as excellent as those of any service—but with the system that gives them no opportunity to learn. Not merely to learn such things by numbers, but by actual practical experience. It means little to the man of average mind to say, "this ship's tactical diameter is 650 yards;" but if he is given the opportunity to turn the ship many times himself, that distance will become fixed in his mind by comparison with the length of the ship itself, and he can look at a space and say to himself instructively and instantly, "my ship can or cannot as the case may be—turn there." It is such instantaneous judgments that must be formed in the heat of battle, and on their being correctly formed depends victory or defeat, the maintenance of a battle line or its break, the destruction of an enemy or a friend.

It must be borne in mind always that the Navy is for war and war only, and that war in the future between navies means actions between fleets of battleships; and anything left undone in the training of our officers to be equal to this supreme test is

criminal, and can only invite disaster and defeat. That every line officer attached to a ship should know its whole capabilities in every particular is indisputable; that many do not is equally indisputable; that much more might be done in the way of training officers to this particular aid than has hitherto been the custom would seem to be more indisputable still.

If our officers, as a whole, are wanting in this kind of indispensable knowledge and experience—and it must be admitted by any candid critic that they are—to what and to whom must we lay the blame, and how may the fault be remedied?

The answer to the first of this question is difficult to formulate. It involves too many elements of expediency and unforeseen circumstances attending the duty and use of ships. There are other elements in it, however, that it would seem might be answered with some show of reason, and a few remarks will be offered on them.

As to "what" is to bear the blame, it may be said with much truth that the whole present system—or rather lack of system—of training, which rarely permits an officer to handle a ship of any kind until he has attained command rank, and leaves him during the best years of his life to pick up such crumbs of experience as he may, must bear the greater part of the burden. It is true that the war with Spain, and the succeeding naval activity in the Philippines, bringing with them many additional small commands have done much to better conditions, and given to many younger officers opportunities for the gaining of experience with responsibility, whose talents would have otherwise remained sunken below the dead level of routine. But valuable to the service as this has undoubtedly been, its influence has extended to only a comparatively few, and, moreover, as a school for the training of officers for war, this species of training can only be considered primary; and the training should extend on continuously until the highest school is reached and mastered—the handling of battleships in fleets.

No definite answer will be attempted to the second element of the question, as to *who* is to blame, as no criticism of individuals is intended in these remarks. There are undoubtedly many questions, international, political, or of expediency, constantly arising in the government of naval matters that must be met by the authorities as best they may, and that interfere seriously

with the carrying out of any fixed programme of training. It is also recognized that there are conditions of service which sometimes render it almost impossible to do all that should be done for the training of officers for war. But aside from all this, it would seem that much more might have been done than has, and that the authorities of the Navy must bear a portion of the blame for existing unsatisfactory conditions.

Given the opportunity, the officers of the Navy have zeal, pride and esprit-de-corps enough to train themselves. But do they have this opportunity and are their zeal, pride and esprit-de-corps encouraged as they should be? Could not all ships in commission at some time in their cruise be required to be maneuvred in all possible ways by all officers on them who may succeed to command, whatever the conditions of service? Does the eliminative of the personal equation by the so frequent changes of officers and personnel conduce to efficiency, and are such frequent changes necessary in so many cases? Could not some system, or approach to a system, be adopted by which the ship, officer and crew would be together long enough to know each other in every particular, even if cruises had to be slightly shortened, and would not such a system tend towards efficiency? Could not officers be alternated in their successive cruises so that they would all, or nearly all, have experience of and be trained in the use of all classes of ships, to the end that an officer who may at any time be called to command a battleship may not have had his whole training in gunboats or cruisers? Could not a more judicious grouping of ships than at present obtains be accomplished for the training of the Navy for war? Is it either economy or policy to scatter our few battleships to work that would be as well or better done by smaller cruisers or gunboats, and thus deprive the service of its highest school for war training—a fleet of battleships?

These are some of the questions that present themselves in any attempt to place the responsibility for the training of the officer not being as complete and thorough as it could and should be. It is beyond the powers of the writer to answer them correctly, and no attempt will be made to do so; but in what follows, in attempting to answer the final part of the original question—how may the fault be remedied?—and in developing his ideas on the general training of officers, some of his opinions

bearing on some of them will appear, and are offered for what they may be worth.

As already stated, it is the province of the Naval Academy to educate the young officer in the ordinary sense of the word, and to give him a preliminary training only that fits him for the beginning of his true training as an officer. This last begins when he joins his first ship, and continues for the remainder of his active career. It is to fit him to handle ships, men and guns, and he can and does learn in the only school for sea-officers—the ship. From its beginning the training should be progressive, and it is the province of the Navy Department to provide for that and to group ships in the manner most conducive to the best training for war.

Since the crucial test in wars to come will be the contests between fleets of battleships, the highest end towards which all training should be directed would be to so train our officers that they could handle a fleet of such ships in action more skilfully, direct and inspire our men better, and use our weapons more quickly and accurately than any possible enemy. These high ends can only be attained by diligent training in fleet and squadron, where not only the actual experience and practice is gained but a healthy rivalry and spirit of emulation is excited in the individual ships that will lead to yet further striving for excellence and superiority. For these reasons it would seem that training for war imperatively demanded that all but the smallest classes of ships be kept in squadrons at all times not absolutely prohibited by the exigencies of the service, and that the battleships be kept in squadron *always*. The training for battle with these ships is too valuable to admit of its being lost or wasted, nor have we enough of them for detached services that could be as well or better performed by small cruisers or gunboats. With our present number it would seem better practice to keep them *all* in one group; or two groups, at the most, would seem the greatest number permissible. If it is deemed that our interests in the Philippines and the East generally necessitate our keeping battleships in eastern waters, then the smaller of the two groups should be there; and, if any are there then there should be a full division of four always, for no less number is of use for training and tactical purposes. All the others we could

commission should then be formed in one fleet on our own coast to form there the highest training school for war.

In the waters of Europe, in the Pacific and in the Eastern waters should be divisions or squadrons of cruisers according to our needs, that would perform the regular duties of the stations, but come together at regular times, or whenever practicable, for tactical and other exercises. These divisions or squadrons would form the second training school for war.

Attached to all the stations, and in the South American and African waters, should be the number of smaller vessels, gunboats, &c., necessary for the service of the stations. These would form the third or primary training school for war.

Having thus briefly sketched what would appear to be the most rational divisions in the means at hand for the training of officers, the young officer will be again taken up at his first start in the active service, and such suggestions made in regard to his training as appear to utilize to the fullest extent possible both the schools and the natural traits of human nature in the man.

The first and chief need of the officer on leaving the Academy and entering the service is practical experience in the handling of ships and men, and the development of character that comes from the bearing of responsibility and independent thought and action. He has been taught much theory, but, from the necessities of the case, is almost entirely lacking in practice. This he should be given at once, and his training conducted in the manner that he may have the opportunity of acquiring in the easiest and quickest possible way mastery over the two fundamental principles of his profession, the handling of ships and men.

It has been the usual custom to distribute a class of graduates from the Academy among the larger ships in commission for their first regular cruise. For the following reasons, this appears to be manifestly wrong and contrary to the best interests of both the service and the officer. As stated above, his chief need is practical experience in the handling of ships and men. This he will acquire far better and more quickly on a small, than on a large vessel. On the former his duties will be more responsible, as he will be a regular officer of the ship and have to do the duties of one. The number of men he will control will be small, but these he will actually handle. Being and

feeling himself an officer of the ship, he will be a person of far more importance and feel his responsibilities far more than if lost in a crowd on a large ship where his duties would be insignificant, and the work of the ship too large and important to be trusted to his inexperience. The art of handling men is learned by a beginner with much greater ease when trusted with a small number than when lost in masses; and for the handling of the ship itself, he would be a cipher in the movements of the large ship, while as a regular officer of the small one, he would quickly learn his part, and soon be intrusted with the ordinary movements, as any other officer. Moreover, from the greater ease of handling small ships as compared with large, he could easily master the one where he would fail on the other, even were he given the opportunity to try. The underlying principles in the two cases, however, are the same, and when he has once fully mastered the handling of the small vessel, he will be competent to undertake the large when the opportunity occurs later.

If these reasons be true—and certainly the experience of the small vessels during the late Spanish War bear them out—there can be no question that the present practice is an error, and the interests of the service would be far better subserved by starting the training of an officer on a gunboat or other small craft; or, in other words, sending him for his first cruise to the primary school for war training in the classification given above. There he would learn definitely the meaning of "starboard" and "port," what a ship might be expected to do with varying positions of helm and motions of screw, the use of springs &c., &c., and many other questions of practical seamanship and the handling of ships that he might cruise for years under present conditions in a large vessel without ever having an opportunity to prove by his own experience. Further, it is unquestionable also that the development of character under the conditions proposed would be far greater than could be acquired in any other way, for the actual doing of things, independent thought, action and responsibility, however small, carry with them a broadening influence that can never be acquired in strict leading strings.

It is true that by this system the officer will become more or less lax in signaling, the principles of tactical maneuvring and the military precision and alertness that come from fleet drills and competitions. But he gains more of the basic fundamental

principles of his profession—the handling of ships and men, without which all else is useless—than in any other way possible, and his further training is so directed as to correct the lacks of the first period.

For the next step in the training of the officer, to consistently carry on the work begun in the first and to supplement its lacks, it is suggested that his second cruise be not in what has been classified above as the second school, but in the first or highest school; and that on leaving the small vessel he be sent to a *battleship in squadron*. The reasons for this departure from the chronological order of importance of the three schools for war training will be readily seen from the remarks that follow.

The training of an efficient naval officer embraces three essential branches; (1) The acquirement of the ability to handle ships, (2) the power to control and inspire men, (3) the knowledge and use of naval weapons of all kinds and the faculty for teaching others to use them quickly and accurately. While training in all three should go hand in hand as far as possible, no single class of ship is fitted to teach them all together thoroughly, and the main efforts in the first training of the officer should be devoted to the first two in which he is most lacking on first entry into active service, since much more of weapons and their uses can be and is taught by theory during the educational period at the Academy. Furthermore, the order of the branches given above is the natural and logical order in which training in them would be taken up, since proficiency in the first two is a prerequisite for the successful application of the third. The ship must first be handled to join in battle and the crew disciplined to be taught to shoot, or the finest individual gunnery practice in the world is useless. The battle once joined, however, the third branch assumes the primary rôle, and on it more than all other factors depends the issue.

From the necessities of the conditions of the work of small ships—assuming the first training has been in them as recommended—and the limitations of their batteries, training in the third branch will have been more or less sacrificed to the first two for the reasons given above, and will not have progressed as far as desirable on the first cruise. Moreover, the work of small ships being usually detached, and proper fleet and squadron work being impracticable with such vessels any way, the officer will have lost in precision and alertness as previously re-

marked; and something of a spirit of indifference to the higher value of concerted action will have been engendered in him, a spirit which is the natural outcome of inexperience joined to the observation of the isolated and independent work of the small ship.

To correct this spirit, and teach him by practical experience for all time the absolute necessity for concerted action and the means of attaining it, and to carry forward the third great branch of training in the best school for it, it is proposed to send the officer for his second cruise to the *battleship in squadron*. Being in squadron always—assuming the ideas here advocated adopted—and having batteries greater and of greater variety than the cruiser, the battleship beyond all question, offers to the officer at this stage of his training a school for instruction in the elements most needed far superior to the cruiser with its mixed work—varying from squadron to general station work and lesser batteries.

Judging from the almost universal practice of former years, there will, no doubt, be founded in the Navy many officers who will advocate sending the young officer to the battleship squadron for training in his first instead of his second cruise. But if the reasons stated in the foregoing pages be fully considered, it would seem that the order of cruises suggested in these remarks is more consonant with sound reason and the object sought. Until an officer has attained some confidence in himself, some experience of ships and men, has the bearing and habits of an officer, and feels himself one, he is too young for fleet work in battleships and is a cipher in their complements. And if he were sent to the battleship squadron fresh from the Academy, not only would half the value of the actual training be lost, but the development of his character, coming from habits of command and the carrying of responsibility in the small vessel, would be much retarded.

These two first cruises with the training gained in them, the order in which they should be made and the reasons therefore, have been dwelt on at some length on account of their supreme importance in the making of the officer. It is in them that his character as an officer is formed, and in them he learns his profession; and as he proves himself there, so is he likely to continue throughout his career.

Training, however, does not stop here, but should continue

throughout the officer's active life as a never ceasing striving after excellence and a superiority over our possible enemies, and those who would aspire to lead our fleets in battle must be ardent students in the schools for war training to the end. No fixed rules, however, can be laid down after the first two cruises. The law of these two should be as fixed as that of the Medes and Persians; but after that the exigencies of the service will govern an officer's duty to a great extent, and regular alternation cannot always obtain. Yet it is suggested that, whenever it can be possibly accomplished, the officer should be sent to the cruiser squadrons for his third cruise, where he would gain knowledge of the handling of large vessels of great speed and tactical qualities differing from battleships, and at the same time continue to a great extent the training in fleet and squadron work.

From that time, to the reaching of flag rank, the rule should be to alternate the duties of an officer, as far as the exigencies of the service will permit, among the different classes of ships, bearing always in mind the supreme importance of the battleship fleet, *which should be kept officered and manned always.*

It must also be borne in mind that *for the purposes of training for war,* vessels isolated on detached duty are of little value, beyond the training of young officers in their first duties of handling ships and men. For this purpose small vessels are superior to large. Therefore it is reiterated that under all circumstances possible with the duties the Navy is called upon to perform, all ships of larger size should be kept in division and squadron formation.

Further and finally, in all cases and everywhere, whether the ships be large or small, in fleets or single, every officer on them who may succeed to command should *know* his ship and her capabilities in every particular. This can be accomplished in only one way; let the authorities cease regarding the small mishaps occurring in the acquirement of practical experience as something approaching crime, and require every ship in commission at stated intervals to be maneuvred in all possible ways by every line officer on her. There may result a little extra coal and repair bill in the present, but it may mean the difference between victory or defeat in the future; and it is far better, if we are to make mistakes, to do it in the practices of peace than in the crush of battle.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE SEYMOUR RELIEF EXPEDITION.

By LIEUTENANT DANIEL W. WURTSBAUGH, U. S. Navy.

The Flagship Newark arrived off the Taku Lightship on the forenoon of Sunday, May 27, 1900. We found two Chinese cruisers at anchor, one flying the flag of the Chinese Admiral; the usual courtesies were exchanged, and we communicated with Tientsin and Peking. From the information received we were led to believe that there was no danger of any immediate, serious trouble from Boxer uprising. On Monday the regular routine was carried out on board ship, and arrangements were made to land the Legation Guard of 25 marines from the Oregon under the command of Captain J. T. Myers, U. S. M. C. On the morning of the 29th, about 4.00 a. m., a telegram was received which caused another section of marines under Captain Newt. Hall, U. S. M. C., and a company of bluejackets with a 3-inch field gun and Colt's automatic gun under my command, to be added to the guard, all to be sent to Peking if necessary; but probably only the marines would be sent, the bluejackets staying at Tientsin.

The marines, under Captain Myers being all ready, left the ship about 6.00 a. m., as did Admiral Kempff and Captain McCalla, using one steamer and cutter. We succeeded in getting the rest of the force underway about 7.00 a. m., in two cutters and the sailing launch, in tow of a steamer. We carried seven days' supplies, 300 gallons of water, a 3-inch gun, with 100 rounds of shrapnel, a Colt's gun, and 10,000 rounds of 6 mm. ammunition. It was found necessary to charter native boats to cross the bar at this time, which was done, thereby lightening our boats so that they passed. We arrived at Taku

landing at 11.30 a. m., where we found the Admiral and Captain Myers; Captain McCalla, having been refused permission by Chinese railroad authorities to send troops by rail to Tientsin, had made arrangements with the Taku Tug and Lighter Company to take us up by the river, and had then gone by train to Tientsin to make preparations for receiving us there.

About 1.00 p. m., a tug brought a mud scow alongside the dock, and we got our supplies, equipments and men on board, and stood up the river. We kept all hands out of sight in the depths of the scow while passing the forts, as it was rumored the forts would probably fire if they saw troops on board. However, after an uneventful run up the river we arrived at Tientsin about 11.00 p. m. We were the first troops on the scene, excepting an English guard which had been there all the winter. About all the foreign population was down to meet us, and they were undoubtedly glad to see us. We landed with little difficulty and marched up to the Temperance Hall where we were to be temporarily quartered. It was about two o'clock before we got the men shaken down, and before we were rid of the crowd. On the 30th there seemed little enough excitement, so we settled to a routine of drills, with a street patrol at night; on the 31st the foreign troops began to arrive in Tientsin. I am unable to state in what order they came, or in what numbers, as the notes I made at the time were lost; after a conference of the consuls and senior officers it was decided to send the guards to Peking.

On the morning of the first of June, Captain McCalla, U. S. N., with Captains Myers and Hall, U. S. M. C., Naval Cadet Courtney and Paymaster H. E. Jewett, U. S. N., with all the marines, the Colt's gun and three bluejackets, left for Peking in company with English, French, German, Japanese, Austrian and Italian marines and bluejackets. They got through without incident, the Americans being the first to reach the gates of Peking.

Captain McCalla, with his aide Cadet Courtney, and Paymaster Jewett, returned on June 2; this was the last train to get through from Peking to Tientsin. Captain McCalla returned to the ship, and I went into permanent quarters at Tientsin; the situation grew worse gradually, culminating on June 6 or 7 in the attack of Boxers on a party of Belgian surveyors and families trying to reach Tientsin from Poating-Fu. A troop of Cossacks went out to assist this party in, and had a

slight engagement with the Boxers; I telephoned the Admiral at Taku, and on the 8th of June, Captain McCalla arrived in Tientsin with another company of bluejackets in command of Ensign Gilpin. I was directed by Captain McCalla to assume command of the whole, and put Cadet Taussig in command of the first company, with Gunner Sheldon in charge of the three-inch gun.

In the meantime, the city had been divided into sections with certain parts to be defended by troops of one nation, and it had become necessary to have outposts and a line of defence ready, as we were expecting an attack daily.

On the 8th a council was held by the consuls and senior officers, but with little result, as no agreement could be reached. I was not present, but Captain McCalla told me he was not satisfied with the inaction, as he thought a large force should be sent to Peking, as things were beginning to look black in that direction; on the 9th a council was held in the forenoon, and another in the afternoon which lasted into the night. I was told that Captain McCalla said at this council that he was going to start for Peking with his men if no one else did; finally it was agreed by Admiral Seymour, R. N., Captain McCalla, the Japanese Captain, the senior Austrian officer, and the senior Italian officer, to start on the 10th.

The railroad station, and all trains and engines, were seized the night of the 9th by the English. On the morning of the 10th we were at the station at 7.00 a. m.; a construction train was made up with coaches for about 200 British marines, 200 British bluejackets, 130 American bluejackets, 100 Japanese bluejackets, 25 Austrians and 25 Italians; Admiral Seymour was in command, and thus began the Seymour Relief Expedition.

Leaving Tientsin about 9 a. m., June 10, 1900, we proceeded to Yang-tsun without incident. Encamped along the Pei-ho river, in the vicinity of the station, was half of General Neah's army, about 7000 men; this had prevented the Boxers from destroying the Yang-tsun station, and the railroad to Tientsin. About four miles beyond Yang-tsun we found the track torn up for a short distance, the rails left alongside and the sleepers burned. It did not take long to make the necessary repairs, as we carried a supply of sleepers. This road was evidently torn up by Boxers. We were joined by another train loaded with British marines and bluejackets, about 500 in all. We proceeded,

as repairs were made, and about 4.00 p. m., when five miles from Lofa and seven miles from Yang-tsun, a small party of Boxers were seen tearing up the road ahead; a force was sent out on each side of the road which surrounded the Boxers; the latter were armed only with spears and swords, but they resisted until all were killed or wounded; they numbered about 75 in all; the wounded were given all the care possible.

We arrived just outside of Lofa about 6 p. m., and found the track and all sidings torn up through the entire station, and the station burned; we saw a few Boxers in the distance, but could not reach them. We camped here for the night; after supper I was sent with eight men on a hand car back to Yang-tsun to send telegrams, which I got through after some delay, and returned, reaching the camp without incident, about 2.00 a. m. During the night we were joined by a German train, a French train and a Russian train. On the 11th we worked on repairs to the road, got in a siding so that an engine and car from our train could be switched to rear, and sent this in charge of Paymaster H. E. Jewett with six U. S. Marines back to Tientsin to bring fresh supplies and an extra engine out; this was successfully done, Paymaster Jewett returning the same night. On the 12th we were able to proceed about seven miles beyond Lofa, leaving a company of English bluejackets at Lofa to protect sidings. Paymaster Jewett made another trip to Tientsin. On the 13th we reached Langfang about forty miles from Peking and ten miles from Lofa and found the same conditions as at Lofa, rails torn up, sleepers burned or carried away, and station and water tanks and pumps destroyed. The Boxers showed little intelligence in tearing up the road, as we could easily carry a great many sleepers, but if the rails had been destroyed, we could not possibly have advanced by the railroad; rails may be destroyed by burning a few sleepers piled under the middle, when the rail curls up and must be sent to the foundry to be repaired. In China a large quantity of rails so disabled would permanently disable the road, as the rails are of foreign manufacture, and a large supply of surplus rails is not kept on hand. Captain McCalla received a message by courier from the U. S. Legation, Peking. Captain McCalla was placed in charge of the construction train, as our men were doing most of the repair work, being assisted by details from other trains. The Admiral

sent Major Johnston, R. M., with 200 of his men to make a reconnaissance ahead, and if he saw fit, to remain in advance and protect what track was left, as the track showed evidence of having been recently torn up. I was sent on a foraging expedition, and to buy horses or mules, if I could find the owners, if not to take what I found. I returned about 1.00 p. m. with four mules for which I had found no owners. Cadet Courtney was sent out in the afternoon and captured two mules after a scrimmage with a much superior force of Boxers, so far as concerned numbers. On the morning of the 14th the Admiral, fearing Major Johnston had failed to find water, sent me with twenty men, with these mules carrying water, to find him, to deliver further instructions, and to obtain a report of what he had accomplished. I had gotten about a mile down the railroad, when I heard rapid firing at the trains, and a messenger was sent to recall me; the trains had been attacked by about 500 Boxers, who had rushed the Italian sentries, killing four out of six; the Boxers rushed right up to the railroad embankment, but the rifles and Maxim guns simply mowed them down; they stood it for only a few minutes, then what was left ran; we got back in time to join in the chase as they came our way. About 300 Boxers were killed in this attack, while our casualties were the four Italian sentries. About noon I got my detachment under way again, proceeded about ten miles along the railroad, and joined Major Johnston about 4 p. m., where he was encamped in sight of Anting, which is 25 miles from Peking. I informed him of the instructions of the Admiral and of the fight. About 6.00 p. m., he decided that he would break camp and return with me to Langfang, where we arrived about 9.30 p. m.

On the morning of the 15th the construction train had advanced about five miles beyond Langfang. Paymaster Jewett returned and reported that he had failed to reach Tientsin, and that the track was torn up between Lofa and Yang-tsun. A return was now made to Langfang with the construction train, where a council was held; it was decided to switch the construction train to the rear, and to repair the road behind us, in order to keep open communication with Tientsin, as we were dependent upon that place for supplies. This was done, and we proceeded to the first break the same night; on the morning of the 16th we began repairing the track and advanced as far as the

Yang-tsun bridge by the evening of the 17th; here we found the track completely torn up as far as we could see (presumed to have been done by General Neah's Army), and the bridge burned, so that further advance by rail was impossible. The advisability of sending for the other trains and attempting to reach Tientsin by marching, was considered; a decision was not reached, however, but during the night we were joined by the other trains. The Germans who had been left at Langfang reported that an attack had been made on them by Boxers, very similar to the one made on the 14th, only the Boxers did not come so close, seeming to have learned a lesson. The Germans followed them as they retreated, and after advancing about two miles were met by Imperial troops who reinforced the Boxers, the estimated force being about 2000 Imperial Troops. The Germans were more or less in disorder at first, as the rifle fire was a surprise, but they rallied and succeeded in defeating the Chinese, although they lost quite a number in killed and wounded. The commanding officer of the English train and fort at Lofa reported a similar and almost simultaneous attack at that place, with similar results. On the 18th an expedition was sent to the Chinese city of Yang-tsun under the command of Major Johnston, Royal Marines, to endeavor to obtain supplies; the expedition had no trouble, but could obtain nothing except a little rice. Upon its return a council was held, and it was finally decided that we would abandon the trains on the next day, the 19th, and try to reach Tientsin by the river route, using junks to transport the wounded, as we had a total of about 264 wounded, and it was practically impossible to transport them any other way. Forage parties were sent down the river to collect all the junks available. We succeeded in getting six large junks and several small ones, which were divided among the different nations. Supplies were very low, and it was agreed to put all together and serve them out; this gave all hands about a half ration a day for three days.

On the 19th about 4.00 p. m., we abandoned the train and moved down the river. The Americans under my command in three sections, the advance guard, the English bluejackets and marines next, the Germans next, the Japanese next, the French next, the Russians next, and last a company of English marines as rear guard. We moved about three miles down the river

when we camped for the night abreast the boats, with outposts and pickets around our left, as we were on the left bank of the river. On the morning of the 20th we moved down the river at daylight, in the following order: Paymaster Jewett with a 1st Sergeant and two privates as the point; the support, a section of infantry, Cadet Taussig; the Artillery section (3-inch field gun), Ensign Gilpin; and the reserve under Cadet Courtney; Captain McCalla was with the advance guard the greater part of the time. About 9.00 a. m., we had reached a bend in the river near Hia-Choo where the road did not follow the river, but the artillery section had to follow the road. We were in this position when I sighted Boxer flags or banners about half a mile ahead on the edge of a village. I was with the artillery section at the time. I immediately sent word to the Admiral, who was in rear of us, and to Captain McCalla, who was with the point; he had the point to halt, and waited until the artillery section came up. At the same time part of the English column deployed and came up on our left. A shrapnel was fired from the three-inch at a range of 1000 yards, which was answered by rifle fire from the enemy; this was the first rifle fire our men had been under, but they were quite steady, considering that the Chinese had the range very fairly. We fired several shrapnel, reducing the range to 700 yards, but reserved the rifle fire to save ammunition. We could see very few of the enemy, as they were in trenches. After a short time Captain McCalla directed me to take all of our infantry around to the right and turn the enemy's left flank. This was done and we marched right up into the village, the enemy having retreated. We found a rifle and some ammunition in the village, and from the empties discovered that the enemy was armed, at least in part, with Manlicher rifles. The rest of the advance guard came up. We straightened the column out and advanced; the enemy made a short stand on the edge of the next village, but would not let us come to close quarters, or rather within good rifle range. They seemed to gather reinforcements in each village. We kept up a running fight until about 1.00 p. m., when the enemy crossed the river just below Tae-ping. We rested here and ate what we had for dinner, while the junks came up. About 2.00 p. m. advanced, and found the enemy in small parties ahead of us; they made our advance slow; about 4.00 p. m. they made a stand in some force in a village, probably

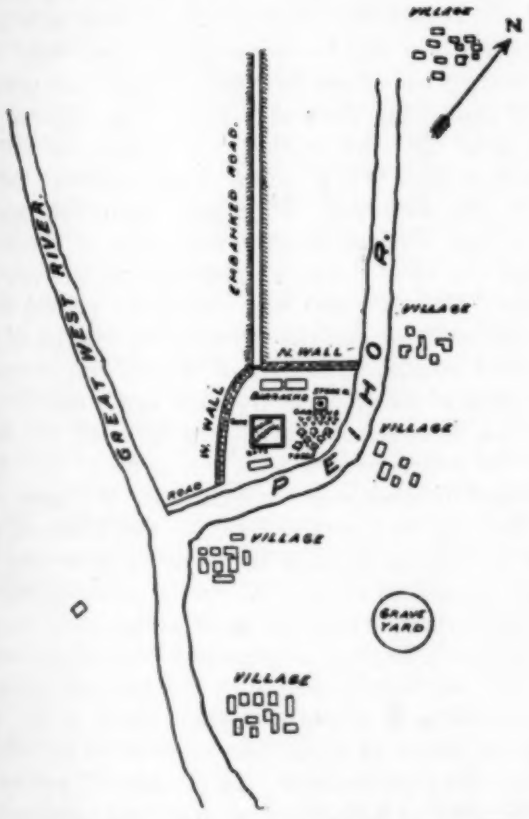
about Hankow. After firing at them some time, and it becoming apparent we could do them no damage as they were in trenches, while we were practically in an open field and were losing several wounded, the Admiral ordered a charge. There were on the line at this time, I think, Americans, English, Germans, and Japanese, and perhaps others. As we charged we were met by what appeared to be the rapid firing of automatic guns, which lasted until we were in the village; we found that the enemy had retreated through the village, and that the rapid firing was fire-crackers, apparently set off to cover the retreat. Our Gunner's Mate in charge of the Colt's automatic gun carried on a donkey was shot in the calf of the leg during this attack with a slug from a jingall or two-man gun. He was the only American wounded. I do not know the number among other nations of the column, not heavy however. We encamped at this place in a hollow square, after burning the village. We were undisturbed during the night. At daylight of the 21st we advanced and found the enemy apparently heavily reinforced, immediately in front and safely entrenched in irrigating ditches. They stubbornly resisted but could not stand a rush, or flank movement. In this running fight the artillery section fell behind, and joined the English artillery consisting of two 9-pounders. About 9.00 a. m. the enemy made a good stand in a sharp bend of the river, taking cover under the bank, and checked our advance for the moment. The artillery was ordered to the front; the only way was an embanked road, apparently swept by the enemy's fire. The English officers in charge of artillery said it was suicidal to attempt it. I said I had orders and must obey them, they said then they would follow. We went over the road on a run, about 300 yards, bullets striking the ground under our feet, but not a man was hit, although the infantry was losing quite heavily. We Americans lost in this fight two killed and three wounded, Cadet Taussig being one of the latter. Captain McCalla was struck by a spent ball which penetrated only his clothing, bruising the flesh. The enemy was driven out, and this was the last stand made during the day, although a running fight was kept up until nearly night, when we encamped a short distance above Peit-sang as before. During the day cavalry and artillery had been seen on our left flank, but had not come near enough to give us any trouble or any chance at them, as we

sent an occasional shell or shrapnel in their direction. It was estimated that General Neah's troops consisting of 7000 well drilled troops had joined the force in front of us. The night was quiet. On the morning of the 22nd we advanced at daylight; we had little to eat except what we got in passing through gardens, and an occasional chicken. Our last actual ration was I think on the 21st. The running fight was begun almost at once, and it seemed more difficult each time to drive the enemy from its position. They made a hard fight at Peit-sang, in fact it was hard fighting all day. About 4.00 p. m. the enemy crossed the river, I think near Nan-Tsang; the Germans were sent across to keep them moving, while the main body of the column advanced until we were ahead of the enemy below Tient-tse-Miaow. The enemy was compelled to move along the embanked road close to the river at this point, as there was apparently a lagoon on the other side, and the Germans in the rear. We had a flank fire with all of our main body and machine guns, three Maxims and one Colt, for about an hour. We were unable to count the enemy's casualties, as night came on, and they were shelling us from a battery down the river, so that we found it necessary to move the junks with wounded up the river a short distance, behind the village of Mun-chia-Chwang. The shelling continued until after nine o'clock. A council was held and the situation discussed: it was found that the supply of ammunition was very low, less than ten rounds per man, except in our case; we had plenty of ammunition left, as we had carried a large supply to stand a siege at Peking. It was decided to put the field guns in the junks and to move at 1.00 a. m. the 23rd, hoping to pass the battery that had been shelling us, before daylight. While the council was being held I discussed the situation with a number of English officers, Paymaster Jewett and Ensign Gilpin; our chances looked black, as it seemed probable that we would have another all-day fight, which meant that all ammunition would be exhausted, when we would be at the mercy of the enemy. There was no thought of surrender as far as I know; the intention was to fight to the last with the bayonet. The council was ended about 11.00 p. m., and we were instructed to be ready to move at 1.00 a. m. I let the men lie down until 12.30; they were almost completely exhausted, and I had some difficulty in getting them up by 1.00 a. m., but they turned

to cheerfully when once awake. By 1.00 a. m. we were underway and moved quietly along the river. I had orders to halt if fired upon, deploy and lie down with fixed bayonets and wait for the English marines to come up on our left. We had advanced about a mile when we were seen by a sentry, who fired his piece and ran back to the village just ahead of us. I deployed and waited for the marines to come up; when they came up we charged the village without firing a shot; the enemy fired perhaps a dozen, when we were upon them with the bayonet. They proved to be an outpost of only a few men. We continued the advance with little delay, in the original order of march.

About 4.00 a. m. or a little later, day was just breaking; I was with Paymaster Jewett and the point, with the rest of the advance guard close in rear but under the bank of the river. The Paymaster and I were walking on the bank so as to see what was on the other bank. Paymaster Jewett discovered a sentry walking his beat on the opposite bank, and we made out two guns mounted near him. The sentry saw us about the same time and spoke to us in Chinese. I sent my men along under cover of our bank single file, and sent word to the Admiral, and to the German Captains, whose men were moving along the bank in an exposed position. The Admiral and Captain McCalla came up with the interpreter, who was sent down to the river's edge to talk with the sentry. A Chinese officer appeared at this time; the interpreter told him who we were, that we wished to reach Tientsin with our wounded, and if they would let us pass in peace we would not trouble them. His answer was a shot from a 9 cm. siege gun. This opened the engagement. I directed two marine sharpshooters to give their entire attention to those two guns and pick off the gunners; they did the work well, as the guns were not fired again, and when we occupied the arsenal we found five dead at one gun and seven at the other. The alarm was sounded in the arsenal by bells, bugles and gongs. Chinese simply poured out of the barracks, and lined the river getting cover under the banks as soon as possible. In the meantime our force was already under the other bank, and we poured in a heavy but careful fire, I continued to move my men along the river, as the enemy could be seen further along. About 8.00 a. m., it being evident that the Chinese would lie and shoot just as long as we would, the Admiral sent Major John-

ston, R. M., with 200 marines to cross the river above, and attack the arsenal from flank and rear. Major Johnston found a road as shown leading directly over the wall, and entered by this, finding no opposition; he attacked the Chinese in rear, at quite close quarters. The Chinese ran, retreating down the river and



across the Great West River. A small force of the enemy had been firing from a Chinese graveyard on our left, and a troop of cavalry and some field artillery were in our rear at some distance.

After the retreat of the Chinese from the arsenal, I said to the German Captain who was next to us in line, that if he would support me and see that I was not cut off, I would clear out the graveyard; he said he would support me any time and place;

I moved my men to the left and advanced on the graveyard by short rushes, going from one irrigation ditch to another. We met some little resistance, and part of the Germans joined us when we charged, driving the Chinese to the west. The artillery to the east was shelling us at this time, and had gotten a fair range, so the Admiral directed us to return, and informed us that he would occupy the arsenal. I was sent with my men to prevent the artillery from coming any nearer, while the rest of the force was gotten across the river. About 3.00 p. m. we went across and landed the three-inch gun. The Chinese continued to worry us all day with artillery fire from front and rear, but did little damage. We found a large quantity of rice and gardens in the enclosure. Rice and vegetables stewed with horse-meat was a fair diet after two days of almost nothing. The arsenal was divided into a number of smaller enclosures, or compounds. The sick and wounded were placed in a storehouse in one of these, and the French took charge of the magazine and shell rooms. The rest of the column camped around the compound in which were the sick and wounded. Captain McCalla was wounded on the instep by shell fire during this fight. I was much pleased with our men in this fight. The brave conduct of many was conspicuous. We were proud that Captain McCalla had obtained for us the advance, and every one tried to conduct himself so as to be a worthy American sailor, and second to none. On the morning of the 24th, the Chinese troops made the only direct attack they ever made on us. About 4.00 a. m., they attempted to retake the arsenal from the west side, but were repulsed by the English marines after a short but severe fight in which Captain Bates, R. M., was killed. They did not attack us again, but annoyed us by rifle and shell fire from a respectful distance. In the arsenal proper we found a great quantity of munitions of war, and ammunition of all kinds, except for Lee 6 mm., with which all the column was replenished. During the 24th, preparations were made for holding the outer wall of the arsenal, thus preventing another inside attack. The Chinese had only four siege guns mounted. The German Captain, Von Husden, was placed in charge of this work, and proceeded to mount the 9 cm. guns found in the storehouses, mounting eight additional; as ammunition was plentiful we kept up a constant fire in direction of tower and the Chinese city of

Tientsin. We sent a Chinese servant who volunteered to try to reach Tientsin, but he failed to get through.

On the night of the 24th the Admiral sent Major Johnston with his marines to attempt to reach Tientsin and bring transportation and relief for the wounded. After a hard fight against heavy odds, he was compelled to return to the arsenal. On the 25th we continued strengthening our position, the Chinese keeping up a straggling rifle fire, and constant shell fire from tower to southwest, which we returned, dismounting the battery in the tower about noon. About 9.00 a. m. a Chinese servant of the British Military Attaché at Peking volunteered to try to reach Tientsin with dispatches. I was sent with a small force to put him across the river about a mile above our position; he was captured by Chinese but swallowed his dispatches and succeeded in deceiving the enemy and got into Tientsin as a Chinese spy. He informed the English consul of our situation and guided the relief column under Captain Craddock, R. N., and Major Waller, U. S. M. C., to us on the 26th. We were relieved about noon of the 26th; during the afternoon we crossed the river and encamped for the night, leaving a force at the arsenal in charge of the ordnance officer of H. M. S. Centurion, to destroy the arsenal. At daylight the 27th we started for Tientsin, going by the railroad, carrying the sick and wounded. Some of our wounded men could walk, but of men fit for duty we had just enough to carry the badly wounded, four men to a stretcher and two to relieve. We were therefore forced to abandon the three-inch field gun, the mechanism being destroyed. Our progress was necessarily slow, although we had no fighting. We reached Tientsin about noon. The sick and wounded received every attention possible, but it was almost impossible to get a doctor of any kind, as we had no doctor of our own. P. A. Surgeon R. M. Kennedy, U. S. N., arrived, I think, on the 28th; his care was incessant, and he saved the lives of two men at least that all thought could not possibly live.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

CONVERTED YACHTS OR SMALL GUNBOATS FOR TRAINING LANDSMEN.

By Lieutenant Victor Blue, U. S. Navy.

Owing to the large increase in the number of ships to be added to the Navy list in the near future and the consequent requirements of a corresponding increase in the personnel in order to make these ships of value to the country, the Navy is now confronted with the problem of how best to receive and shake down into place a large influx of undisciplined and inexperienced men without manifest injury to discipline and efficiency. In order to meet these demands, inexperienced men, apprentices and landsmen, must be enlisted and trained for the service expected of them, before they can be of use in the Navy.

With the prospective policy of a large yearly increase of the number of landsmen this problem of training becomes a serious one.

The proposed scheme for assisting in the handling of this important question, as outlined below, would seem to be a feasible one, as it contemplates utilizing the facilities already at hand without extra expenditure, and the employment of a minimum number of officers and experienced men to accomplish beneficial results. It is not devised with a view of displacing the system already in vogue on board the landsmen training ships, but for the purpose of supplementing that system or acting as an auxiliary to stationary training ships or shore training stations by utilizing other available resources of the Navy in training landsmen that cannot be provided for on regular cruising training ships.

It is proposed that a number of converted yachts and small

gunboats be used in connection with the Lancaster, Franklin and Richmond, or shore training stations. Whether these ships are to be used as stationary training ships on board of which recruits would undergo a probationary period of training of six months before transfer to the cruising training ships, or whether they are to act simply as receiving ships to care for the recruits until a cruising training ship is available, it is submitted that the auxiliary gunboats would be of great assistance to them in the training of the men.

For the sake of illustration and of explanation of the proposed plan, ten gunboats of various sizes are selected at random from the Navy list, and their permanent and training complements tabulated for the purpose of showing the relative number of officers and men required and the number of recruits that can be instructed.

The scheme contemplates that several gunboats be attached as auxiliaries to each of the stationary training ships, Lancaster, Franklin and Richmond, or to shore training stations. The gunboats to be regularly in commission with a commanding officer and a small permanent complement of selected men. By being regularly "commissioned," and not "tenders," the duty would be "sea service" and consequently give an idea of permanency to the officers and men and cause them to take increased interest in their work. The writer thinks that the liability of frequent changes in the details of these small vessels, if they were not regularly commissioned, would not be conducive to the efficiency of the system.

However, these auxiliary training vessels should be subject at all times, as to their movements and routine of instruction, to the orders of the captain of the mother ship to which they may be attached. This would be essential in order to promote uniformity in the instruction and grading of the men.

The gunboat would take its complement of recruits from the mother ship and cruise for a specified time in the neighboring inland waters, anchoring at night and getting underway again the following morning. After working in this way for a length of time, which would be found to be sufficient for the purpose of having the men become proficient in the instruction given, it would return to the mother ship, exchange for a new detail of landsmen, take on coal and provisions, and proceed on another cruise as before.

Auxiliary training vessels attached to the Lancaster could have for their training grounds the sounds of South Carolina and Georgia, and those attached to the Franklin and Richmond, the Chesapeake Bay with tributary rivers.

The following course of instruction suggests itself, as being the groundwork upon which every man-of-war's man should have a firm foundation:

1. The lead and line—markings, sounding.

2. The construction of the compass—boxing the compass, helm-steering.

3. The log line—marking, heaving, patent log, ground and current logs. Reading thermometer and barometer.

4. Anchors and chains—letting go, heaving in, veering, &c., the capstan and windlass.

5. Lighthouses, buoys, beacons, fog signals, rules of the road, tides and currents.

6. Boats—hoisting, lowering, coming alongside, sailing, pulling, &c.

7. Ordnance—nomenclature and use of small arms and secondary battery guns, cleaning and caring for same, ammunition, magazines.

8. Gunnery—target practice with small arms and secondary battery, subcaliber practice, principles of aiming.

9. Signalling—wigwag and flag.

10. Swimming.

The recruit would acquire a good working knowledge of most of these subjects in a natural manner; that is, by being required to perform the duties pertaining to them constantly while the vessel is under way, anchoring, or getting under way. While steaming the log and lead would be kept going continually.

The system contemplates having the recruits do all the work of the vessel under proper supervision, except in emergencies, going in and out of port, etc., when it might not be deemed advisable. In addition, individual instruction and drills would be given.

The feeling of responsibility, which comes to a man when he is required to do the regular work of the vessel, materially aids in the rapid acquirement of the knowledge of his duties.

It is the firm belief of the writer that with a system of training of this kind, if the officers in command of the training gunboats

were especially interested in the subject and were zealous in keeping up the course of instruction as outlined, the recruits would in a month's time learn more about the elementary principles of seamanship and lay a better foundation for becoming useful man-of-war's men than could possibly be accomplished in many months spent on large training ships, where their individuality is lost among the hundreds of others, and where they come to look upon lectures and drills as irksome.

In a small vessel a man is better able to comprehend what orders mean and how to carry them out. The contracted space permits him to see and know all that goes on and to understand the various reasons why things are done.

Under these circumstances an inexperienced man will rapidly absorb the knowledge of many of his duties more or less unconsciously, or without much effort of his mind.

It is not for a moment contended that this short course of training on a small vessel is sufficient for the recruit, or that small vessels should supplant large ones in the training service, but it is believed that a preliminary training as described above would be of incalculable benefit to the recruit, whether he subsequently goes to a large training ship or to a cruising ship, and that it would fit him to begin at once the intelligent performance of many minor duties, and at the same time make him better able to grasp the details of more intricate ones.

The writer has been informed by a Russian naval officer that a system of this kind is now employed in the Russian Navy, and that it has given very good results. Small torpedo boats of an obsolete type are used for the purpose.

It will be conceded that some men learn more rapidly and adapt themselves to the conditions of ship life more readily than others. On board a small vessel, where the commanding officer has a personal knowledge of every member of the crew, such men can be easily classified or graded. Hence, it is the opinion of the writer that six months spent on a stationary training ship, including a month of instruction on board an auxiliary training gunboat, would fit the recruits for immediate transfer to regular cruising vessels of the Navy without making a cruise on board a large training vessel. This opinion is based on the experience of the writer, who happened to be Executive Officer of a gunboat during the war with Spain. This gunboat was

fitted out at Norfolk and carried a crew of sixty-three enlisted men. The draft of men sent to her from the Franklin consisted of five men who had served in the Navy before, and not more than five others of the deck force had ever been on salt water. However, in a month's time these men with few exceptions were doing their duties in active service on the coast of Cuba in a very satisfactory manner. An ex-marine made an excellent quartermaster, and many of the other raw recruits were satisfactorily performing important and responsible duties in the boats, at the guns, at the wheel, etc., as required. These men were from the same class and walk of life from which our landsmen now come. It may be here suggested that, for the sake of experiment, one of the small converted yachts of the Siren or Sylvia class might be commissioned for the purpose of testing the system and of determining the length of time required for the recruits to qualify in the subjects mentioned above. With a permanent complement consisting of one officer, ten men of the deck force and five of the engine and fire room force, this small vessel could take out twenty-eight recruits (25 landsmen and 3 coal passers). At the end of a month's time she could be thoroughly inspected by the Board of Inspection and Survey with a view to determining the efficiency of the system. Such a test would be of very small expense to the Naval Service in personnel, and would require no extra appropriation from Congress. The report of the Board could decide whether or not the system should be continued.

It is the amount of individual training given each man and the practical experience gained by him that will count for efficiency in the end. Compare a large training ship carrying 400 landsmen—during a six month's deep water cruise; how many hours would each of those men spend in heaving the lead and in steering; how much practical experience would each one gain in anchor and ground tackle work and boat work?

An officer of the training service in a recent article on "The Training Ship" published in the PROCEEDINGS OF THE NAVAL INSTITUTE says, it would be impossible to take a class of 112 young men through the training ship course and give each one much individual instruction, and that each period of instruction would amount to a lecture when but few could have any individual work to perform. As an illustration he cites a case in

which each apprentice in a class of 112 received only one hour's instruction in heaving the lead during a six month's cruise on a training ship. This statement is not surprising when it is realized that one officer must attend to the instruction of from 80 to 100 men. All these men must necessarily be instructed in the same thing at the same time, or many of them must remain idle while a few are given individual instruction. In the former case the amount of each man's learning would depend on his individual aptitude, while in the latter case the period of idleness could only be conducive to laziness, inattention, and discontent. The old rule of making a "happy ship" and an efficient ship by keeping every one busy from morning till night can well be exemplified in a small vessel carrying out the routine of instruction as proposed herein.

Moreover, aside from the technical knowledge to be instilled in the recruit, there is another matter of vast importance, which is too often overlooked or neglected. This matter pertains to the etiquette and customs of the Naval Service—the respect and deference due to superior authority, which alone can be depended upon to bring about absolute and implicit obedience. This, it is claimed, is the first requisite of naval training. A man of ordinary intelligence will sooner or later acquire enough technical knowledge to get along with minor duties; but what of discipline if respect and obedience are not inculcated in him from the very beginning? The fact of an enlisted man not rising when spoken to by an officer or not saluting him when passing are small matters when viewed from a personal standpoint, but small things are the ones that count and are the essentials in primary training. It is submitted that in a small training gunboat where every man is almost constantly under the eye of the commanding officer and personally known to him, any infraction of the rules of the service in this connection can be more readily and easily detected and corrected than could possibly be the case in a large training vessel carrying 300 or 400 recruits, where many of the men are not even known by name to their own division officers.

The ten vessels shown in the tabulated list are taken at random. Many of them are loaned to the Naval militia of various states and could be reclaimed for this service. The numbers given in the table are only tentative and could be increased

or diminished according to the necessities of the case in each particular vessel. The estimated complements are based on the writer's experience with similar vessels.

For the sake of illustration, suppose the Franklin or the Lancaster had on board 400 landsmen for a six months' course of training and that three similar vessels to the Siren, Sylvia, and Aileen were attached to her as "auxiliaries." By referring to the table it will be seen that these three vessels would require permanent complements of three officers and forty-three enlisted men all told, and that they could carry for training purposes 70 landsmen and 8 coal passers. Assuming that the gunboats would cruise for one month with each draft of recruits, in six months' time 420 landsmen and 48 coal passers could be put through the course suggested herein. While underway the disposition of the recruits could be as follows:

1 at the wheel.
2 at the lead on each side.
2 at the log line.
1 on lookout to report and describe lighthouses, buoys, beacons, vessels, etc.

For practical illustration of the working of such a system a vessel of the Siren class carrying 25 landsmen may be taken as an example. Steaming at least eight hours a day for five days in the week would mean 160 hours underway during the month. During the course of instruction each recruit would then have to his credit:

6 to 7 hours at the wheel actually steering the vessel.
6 to 7 hours on lookout reporting on buoys, beacons, etc.
600 casts of the lead.
80 times heaving the chip log, reading patent log, and barometer and taking temperatures.

Every cast of the lead and every observation would be made systematically and recorded in a book provided for the purpose.

If the vessel anchored twice a day, at noon and evening, it would mean forty times during the month that the recruits would have practical experience in letting go and in weigning the anchor.

While at anchor a recruit would be required to stand watch with the quartermaster and make hourly observations of the wind, weather, tides, etc., for entry in the log. This would

give each man 18 hours' experience in this sort of work during the month.

These points are only referred to here to show some of the practical experience the men would gain during the progress of regular work, not included in periods of instruction and drills. They include certain elements of seamanship, which are practically the same on all vessels whether large or small. The inference then is that in small vessels where there are few men to perform these duties, every member of the crew would gain more experience in them than would be the case on a large vessel with a large crew.

The permanent crew should be selected men; preferably seamen who are qualifying to become petty officers, and petty officers who are qualifying for advancement.

Incidentally, the system as regards the permanent complement would be a good school for the petty officer on account of the responsibility he would have and the instruction he would be required to give under guidance of an officer.

Name of Vessel.	Displacement.	Permanent Complement.													Coal Passers under Training.	Landsmen under Training.	Total under Training.	Total Ship Complement.
		Officers.	Petty Officer Deck Force.				Total Petty Officers.	Seamen.	Messman Branch.	Total Deck Force.	Fire Room Force.			Total Permanent Complement.				
			Boatswains' Mates and Coxwains.	Quartermasters.	Gunners' Mates.						Machinists.	Firemen.	Total.					
Wasp	630	2	3	3	1		7	4	3	14	2	3	5	19	3	40	43	62
Stranger	546	2	3	3	1		7	4	3	14	2	3	5	19	3	40	43	62
Hornet	425	2	3	3	1		7	4	3	14	2	3	5	19	3	35	38	57
Hawk	375	2	3	3	1		7	4	3	14	2	3	5	19	3	35	38	57
Siren	315	1	2	2	1		5	3	2	10	2	3	5	15	3	25	28	43
Sylvia	302	1	2	2	1		5	3	2	10	2	3	5	15	3	25	28	43
Aileen	192	1	2	2	1		5	2	2	9	2	2	4	13	2	20	22	35
Elfrida	173	1	2	2	1		5	2	2	9	2	2	4	13	2	20	22	35
Inca	120	1	2	2	1		5	2	2	9	2	2	4	13	2	15	17	30
Alvarado	100	1	2	2	1		5	2	2	9	2	2	4	13	2	15	17	30
Grand Total		14	24	24	10		58	30	24	112	20	26	46	158	26	170	296	454

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THE RESULTS OF THE NAVY PERSONNEL LAW OF MARCH 3, 1899.

By LIEUTENANT EDWARD L. BEACH, U. S. Navy.

Three years have passed since the law reorganizing the commissioned personnel of the navy went into effect, and though this time is far too short to claim that the law has had a fair working test, yet it may not be out of place to discuss the effect of the law during its three years of life.

The proposed Personnel Bill was a constant theme of discussion, both in the service and out of it, for the year and a half before it became a law; it has been noticed that those who then most strongly opposed it, have never changed their position toward it, and these claim that in the three years of its operation there is abundant evidence that the impossible has been attempted; on the other hand those who originally advocated this law are still its friends, and maintain that it has already proved to be a success, and that there are signs that our example of having but one corps of officers for both deck and engine room duties is soon to be followed in other naval services.

The remarks that follow are prompted by a desire to view without prejudice the present conditions of the naval service that have, in any way, been influenced by this law.

The astounding feature of the Personnel Law was the amalgamation of line and engineer officers into one corps; to many of our own citizens and to most all foreigners interested in naval matters, this was the only feature; yet there were other changes made by the law, which, though perhaps of not so startling a character, were of equal importance; all agreed that the other changes proposed would partly relieve a distress that for years

had existed in every grade in the naval service; this explains why many officers who emphatically disapproved of the amalgamation proposed, still hoped for the passage of the bill. The reason that induced officers who condemned amalgamation as utterly Utopian, to hope that the bill would be made a law, was because some features of the bill would to a certain extent relieve conditions in the naval service that were intolerable. For seventeen years the personnel of the navy had been regulated by the law of August 5, 1882, a time when the Tennessee and the Trenton represented our highest type of warship, when not even the Atlanta was contemplated, and when the Oregon was an undreamed of possibility. This law, which limited the number of officers in each grade of each corps, had solely in view the needs of the navy in existence at that time. No new ships were being built, designed, nor were in congressional contemplation. In but a short time later came the awakening to the necessity of naval protection, and the upbuilding of the navy began. This law of August 5, 1882, provided that in certain grades there should be, until a specified limit was reached, but one promotion to every two vacancies made; and thus was presented the extraordinary spectacle of the country suddenly becoming possessed of great naval ambition and activity, devoting huge sums to the building of ships and to extending the naval establishment, increasing the naval enlisted force by thousands, and yet permitting the number of officers each year to steadily decrease. Germany, in recently ordering a gradual expansion in her naval establishment, provided for an increase of officers and men in proportion to the increase of ships, a method obviously as necessary as it is sensible, whereas, though our country had determined upon a naval strength commensurate with its interests and commercial importance, yet it had absolutely neglected to provide for an adequate number of officers required by the increase in all directions in the strength of the naval establishment. It must be admitted that for this neglect naval officers were to a certain extent to blame; congress has been of disposition to allow the naval officers themselves to decide upon their own needs; long ago congressmen agreed that the existing conditions in the navy personnel were intolerable, and that continuance of them was impossible, and they promised to pass any measure that the naval officers would unite upon as being the

correct one to do away with the existing troubles; but the line and engineer officers could never agree; each corps always antagonized any measure of legislative character that was advocated by the other. The views of line officers found expression in the Meyer Bill; the engineers felt this proposed law belittled their usefulness, and injured them personally and professionally. Under these circumstances there was no chance for the Meyer Bill to become a law. The engineer officers had their views expressed in the Wilson Bill, which the line officers held in the most extreme disfavor, so the line officers destroyed any possibility it had of becoming a law. Congressmen were aware of the distress that existed in the personnel of the navy, and wished to relieve it; but the Navy Department itself made no recommendations and took no action, and congressmen listened to the views of individual officers, and under these circumstances for the time being no legislation for the relief of the personnel was possible. In the meantime the conditions confronting the Navy Department grew to be appalling; many new ships were commissioned and many more were being built, the war with Spain was clearly impending, and still the navy was officered by the needs of 1882, not of 1897. Finally the Navy Department appointed a committee to consider and report upon the needs of the naval personnel; the result of the labors of this committee was the formation of the Personnel Bill, which was presented to Congress with the approval of the Navy Department; it became a law on March 3, 1899.

The startling feature of this law was the amalgamation of line and engineer corps into a new line, and the requirement of the officers of the new line for readiness for duty either on deck or in the engine room. The most important change made by this law was not, in the minds of many, this amalgamation, but was to officer the navy with some respect to present necessities, and to provide for a proper flow of promotion. Due to the inequalities of governing laws we have recently had rear-admirals retire with but fourteen years of sea-service, and lieutenants die with nearly twenty-five years sea-service. Due to these laws our officers of present highest rank generally attained to the grade of lieutenant-commander before they were twenty-five years old, while officers of but few years their juniors in length of service did not attain to that grade until they were nearly fifty years old.

It was the great distress that existed in the navy personnel because of the controlling laws, and which the Personnel Bill went far to relieve, that caused this bill to become a law; the only doubtful feature in the proposed law was that of amalgamation; some believed in it, some did not, but all were heartily glad that hereafter there was to be a regular flow of promotion. Many officers who were glad to see the Personnel Bill become a law, at all times said that there was no need of this amalgamation on one hand, and no possible hope that it would be productive of good results on the other. This view was held at the beginning of the discussion by prominent officers of both corps. There are other officers of both corps who at the beginning warmly advocated amalgamation, and who to-day maintain that it has been successful in its operation, and that it has met every need. There are still others who look upon the success of amalgamation as problematical, and who believe that changes must be made in the near future. The fact that after three years of operation, officers have not changed their original opinions on this subject, is evidence that a three years' test is not long enough to settle the question as to the good or bad effects of amalgamation. But the very fact that it is not settled is alarming. One condition that has operated to prevent this from having a fair trial, is the shortage of officers for both deck and engine room duty.

Our course in requiring line officers to be ready for duty either on deck or in the engine room has awakened the greatest of interest in the foreign naval services. To the British it has been amazing. The British line and engineer officers have but little practical conception of each other's duties, they are educated at schools that have no connection, that have no drills or studies in common. All except a few of the senior officers of our line and engineer corps were graduated from the same school, were taught in the same classes, all have gone through much practical work in the different shops, most all have studied in common,—engineering, gunnery, navigation, seamanship, electricity, etc., and thus, though amalgamation was impossible to the British Officer's mind, it was not unnatural to our service. There is another feature to be considered, and that is that our line and engineer officers do not come from different social classes, whereas, as a rule, the British line and engineer officers

do. The representatives of great families in the Royal Navy are to be found in the line, not among the engineers. The British line is essentially aristocratic, the engineer corps entirely the reverse. British officers have informed the writer that this difference in class would always be an insuperable bar to the amalgamation of these corps in the British service. In the case of the German, Russian, Spanish, and Italian naval services, those officers who come from aristocratic families are to be found in the line, not among the engineers, whereas the families of the French line officers are generally from the bourgeois class. As a result the line officers of the British, German, Russian, Spanish, and Italian services vehemently declare that amalgamation is a failure in the American navy, and that from the first it was impossible of good results, whereas French line officers of high rank are now advocating amalgamation to be a natural and inevitable result of naval progress, and are recommending that it be adopted in the French navy. The British service denounced this combination of duty from the start, and long before there was time for the slightest trial of its merits, British officers proclaimed that amalgamation was everywhere in the American service acknowledged to be a complete failure. Considerations of naval service show that not for many years can it be positively stated that amalgamation has been a success or a failure, because for many years to come the captains of our ships will still be officers who were originally line officers, and the chief-engineers of the most powerful ships will be officers who were originally engineer officers.

It may be well to examine to what extent the Personnel Law has been carried out in our service; the first effect was, at one blow, to stop all watch standing by commissioned officers in engine rooms, except in special instances which were for but brief periods of time. Engine room watch standing has since been done by warrant and by chief machinists. In some of the greater ships junior line officers have been detailed as assistants to the chief engineer, and have in these capacities, rendered efficient service. Some officers originally of the line, and who have had previously but little if any real engineering duty, have been ordered to duty in charge of the machinery of such ships as the Dixie, Prairie, Puritan, Lancaster, Detroit, and many others. Of the former engineers, those who graduated from

the Naval Academy after 1883, were required to qualify for line duties, and five of the former engineer officers who graduated before this date were permitted to qualify for line duties. During the two years following the passage of the Personnel Bill, all of these former engineer officers were required to perform line duties, and with but one exception, this duty has been watch standing. Thus it seems to be the expression of the department's opinion that experience as watch officer is essential to be efficient as a line officer, but that engine room watch standing is not necessary to be efficient as an engineer. On the other hand it is to be noted that the Engineer-in-Chief has reported that the present method of carrying on engineering duty is not conducive to engineering efficiency. He believes that to be an efficient chief engineer in these days of great requirements, one must have served an apprenticeship at engine room watch standing.

At the present time but few officers are heard to express themselves as being entirely satisfied with the outlook for engineering in the navy, and yet no one doubts but that the material for the line is being as well developed as it has always been. The reason for this is that none of the young officers are serving any practical apprenticeship in engineering, and all of the theory in the world will not develop practical engineers; officers who were originally of the line and are now ordered to duty in charge of the machinery of some ships, must know that their engineering duty is but temporary, and they do not expect to be as efficient in the engine room as they are on deck, nor do they desire to be so. On the other hand many of the former engineer officers feel that much line duty may be required of them in the future, and that they must bend all of their efforts to become efficient as deck officers. In both cases engineering suffers. It is well to consider the young officers of the service; does the present outlook promise that they will become as efficient in engineering as those who were graduated as cadet-engineers previous to August 5, 1882? Between this date and 1890, there was no special course in engineering taught at the Naval Academy, and no cadets were graduated with assignments to engineering duty. Previous to 1882, the instruction given to the cadet-engineers was probably the best given anywhere in the country, which is attested by the fact that it was copied as a

model by most of the technical schools of the country. Its character is shown in that it produced such men as Hollis of Harvard, Spangler of Pennsylvania, and Cooley of Michigan universities. There still remain in the service officers of the stamp of Bailey, and Griffin, and Bowles, and Theiss, to remind us of its excellence; when one thinks of the engineering knowledge possessed by these officers, the question naturally suggests itself as to whether the service is to-day developing in it as able engineers as were being developed ten and twenty years ago. There can be no doubt as to the answer to this, nor to its emphasis. It is remarkable that the best known engineers of those days are the best known of to-day; there are not to-day as many young officers known for special ability as engineers as there were ten and more years ago. Should the question be asked as to whether the service is now developing line officers of equal ability to those of former years, the answer would be that it is; therefore, considering the unrivalled engineering opportunities of the present day, the fact that great engineering ability is not being developed at present in the navy, must be considered as amazing and intolerable.

On her contract trial trip in 1894, the Minneapolis had maintained a speed of over 23 knots an hour. Upon her return to Philadelphia a banquet was held on board, at which the Engineer-in-Chief of the navy was given the credit for her wonderful performance, and was asked to what he ascribed his great success.

He replied, "To the young engineers of the navy, they did the work; the credit that is due me comes from knowing whom to choose for my assistants." It is surely alarming that the Engineer-in-Chief has for his immediate assistants to-day nearly the same group of officers that surrounded him in 1894 and also in 1888. The reason for this is that since 1882, with rare exceptions, there have not been graduated from the Naval Academy officers possessed of as much engineering knowledge as was possessed by the former cadet-engineers when graduated. And so these formerly young assistants, who are now middle aged, have not, judging from the engineer's standpoint, had successors of equal engineering knowledge and ability. From 1882 until 1890 the course of engineering taught at the Academy was for line officers only. From 1890 to 1899

some cadets were given special instruction in their last year at the Academy, in engineering subjects, which cadets were permanently assigned to engineering duty; for the last three years all of the younger former engineers have been devoting themselves to other than engineering duty, and if the question were now asked, "Who are the real engineer officers of the service to-day?" the answer would surely be, "Those officers who were graduated as cadet-engineers previous to August 5, 1882." In expressing these views several questions occur to the mind, such as, "Why is it that the conditions now existing in the naval service do not tend to develop great practical knowledge of engineering?" and, "Is there real need of such knowledge?"

To answer the second of these questions, one has but to consider the 15,000 ton cruisers and the 17,000 ton battleships now under construction for our navy. It may be assumed with certainty that neither the Bureau of Navigation nor the Bureau of Steam Engineering would ever permit the mechanism of the great battleship or of the great armored cruiser, to be in charge of the dilettante in engineering; it is certain that for the immediate future the officers in charge of the machinery of these great ships will be those who were graduated as cadet-engineers, but in less than ten years all of these officers will be commanders in rank, and therefore not available for sea-service. From the present outlook one may doubt that these officers are to be succeeded by officers of equal engineering ability, and this prompts one to ask if mediocre ability, or inexperience, are to be tolerated in such positions?

When one thinks of all that was said during the discussion of the proposed amalgamation, of the fact that considerable engineering duty was to be required of all the line officers, and when one sees that many officers originally of the line are now giving efficient service as engineers, one may be surprised that such pessimistic views regarding the future of engineering are held.

It is here submitted that the course of engineering taught at the Naval Academy is excellent, that the young officer is properly started in engineering, but that the conditions met with after graduation are not such as to produce officers of great engineering skill, such as is needed by those who are to be in

charge of great engineering establishments; that this is not due to any lack of attraction of engineering for many officers, but because of the present lack of finality of engineering duty.

In this last lies the cause of the surely impending engineering mediocrity in our service. If duty on deck led finally to engineering there would be no such danger. To be in charge of the machinery of one of our great 17,000 ton battleships will be but a step on the way to command, and perhaps to flag duty. To be efficient in charge of machinery of such great power must mean years of preparation, complete familiarity with every detail pertaining to the establishment, perfect dependence upon self yet ability to know when to make use of the suggestions of subordinates. Such qualities are not to be had from officers who spend years of their time at other pursuits on one hand, and on the other hand when the officer in charge of the machinery of the great battleships knows that in succeeding cruises his duties will be solely executive. No matter how much the officer's inclination may lead him to engineering, the latter part of his career must be in command duties, and for efficiency in command, all line officers must shape their careers; and thus efficiency in engineering cannot possibly be the ambition that urges one on, and without this ambition great engineering ability will not be developed. So long as efficiency in command is the great and the final goal toward which all officers must strive, so long to these officers will engineering be but an incident in the march, and for this reason the effect will be that our officers will become efficient as deck officers, and dilettantes as engineers; not because deck duties are easier or more attractive, but because ability in engineering is not the great and the last purpose of any career so long as the conditions and laws affecting the naval service remain as they are at present. And thus mediocrity in engineering is surely threatening the near future of our naval service. The writer does not believe that this necessarily means disaster to the navy. The line officer in engineering positions will never play the fool; it is probable that engineering mediocrity will have the effect of requiring much navy yard repair that should be performed by the complements on board, that ships will be laid up for longer times in port, that the machinery and boilers will not be kept up to their highest efficiency, that steaming will not be at economical coal expenditures, and that

the highest designed sustained sea speeds—not contract trial trip speeds—will never be attained.

The trend of naval opinion to-day is that some change with regard to engineering duty must be made; there is as yet no well defined opinion as to just what this change should be; it is generally believed that a new engineer corps will be established in the near future, but no detailed plan for this has been submitted for naval discussion or consideration. It is not the purpose here to condemn amalgamation as having accomplished no good results; it has silenced completely the old line and staff quarrels that for so many years had disturbed the naval service, and had undoubtedly hindered naval efficiency; in certain particulars the officers of the deck and of the engine room have a better appreciation of the duties and the motives of each other, and in many places content has replaced dissensions. The deck officers have a fuller knowledge of the work done below, and the engineers understand more clearly the imperative features of some duties that had seemed unnecessarily harsh. In considering the creation of a new engineer corps, the question comes up as to whether it is not possible to retain with the new corps the good results accomplished by amalgamation, and at the same time have a corps of officers whose great ambition may be to become skillful and able to the highest degree in engineering, who may have no other professional incentive. The young men entering the service to-day are surely as naturally capable of becoming able engineers as their predecessors were, but under the present conditions it is probable that most of them will become excellent line officers, with a varying degree of ability in engineering from tolerable to very good. What is needed is that for some officers, engineering should be the great purpose of their naval careers.

In submitting his views the writer realizes that many officers will differ from them. But it is the opinions of naval officers who have had the actual experience of the workings of the Personnel Law with respect to amalgamation that will outline the features of the new engineer corps. There are some questions affecting the naval service that from their nature can only be understood within the navy, and which must be settled by the officers who understand them. There are no people so competent to decide as to the virtues of the amalgamation features

of the Personnel Law as those who have had personal contact with its workings. The writer believes that the time has come when the workings of amalgamation should be thoroughly discussed by the naval service, the discussions to be published in these Proceedings.

In suggesting particular changes of the present law that would tend to produce the engineering ability that the requirements of the navy demand, the writer assumes that it is advisable to retain amalgamation to a certain extent; that it is well agreed by naval officers, that those who were graduated from the Naval Academy as cadet-engineers, who are now or soon will be of the rank of lieutenant-commander, will not, with some rare exceptions, be succeeded by officers possessed of equal engineering ability; that great engineering ability is not, at present, being developed in the navy, and that under the provisions of the Law of March 3, 1899, it never can be, because under that law the great purpose of the naval career must be to attain efficiency in command, and not efficiency in engineering; that the great battleships and armored cruisers of the immediate present and future require that the officers in charge of the machinery be possessed of great skill and ability as engineers; that it is now time to provide that there may be some officers whose highest incentive may be to become efficient engineers, and that if this is not done mediocrity and inefficiency in engineering must ensue, as those officers who were graduated as cadet-engineers will all, in less than ten years, reach the grade of commander, and therefore become non-available for sea-service.

The following changes are suggested in the belief that the desired results would follow. It is not presumed that they are the only or the best changes that could or that should be made.

The purpose of these suggested changes is to attract those officers who by experience, and not by fancy alone, are conscious that engineering is the proper field for their abilities; also, to create conditions so that for such officers, engineering ability and not efficiency in command, may be the great incentive influencing them.

Hereafter an officer will reach the rank of lieutenant junior grade before he is twenty-five years old. Before this he will have had much instruction and duty, both in theory and in practice, on deck and with engines, and he will know in what lies his

best abilities; it is time that he should determine definitely whether his best energies should be given to line or to engineering duties; with this view, for the efficiency of the navy, it is submitted that in the grades of naval cadet after graduation, and ensign, the duty should be systematically divided between deck and engine room watch standing; that upon being commissioned lieutenant junior grade, the officer should be permitted to select either the line or engineering duties for his permanent place in the naval service; experience would show to what extent the numbers allowed to select either duty would have to be regulated; the lieutenant junior grade thus allowed to elect engineering for his future permanent duty should be required to take a post-graduate course in engineering at the Experiment Station to be established at Annapolis; following this, he should be assigned to duty as assistant to the chief-engineer of a first-class battleship or armored cruiser, and later in charge of the machinery of a fourth-class ship; upon examination for promotion to the grade of lieutenant, the examination should be in engineering of so high a standard that to be successful must have required on his part earnest application to engineering duties; upon promotion to be lieutenant he should be made an extra number upon the navy list, keeping his relative place in all the grades, being reserved entirely for engineering duties; in the grade of commander he should be required to serve no longer than three years at sea, and then in only the most responsible positions; after this the duty required of him should be engineering duty on shore suitable to his rank.

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McCORMICK'S NAVIGATING PROTRACTOR.

By LIEUT. CHARLES M. McCORMICK, U. S. Navy.

The protractor consists of three concentric rings, each of which has movement in azimuth with regard to the other, and each has a diameter subtended by a wire so that, by motion of the rings, the wires may be set to intersect at any desired angle.

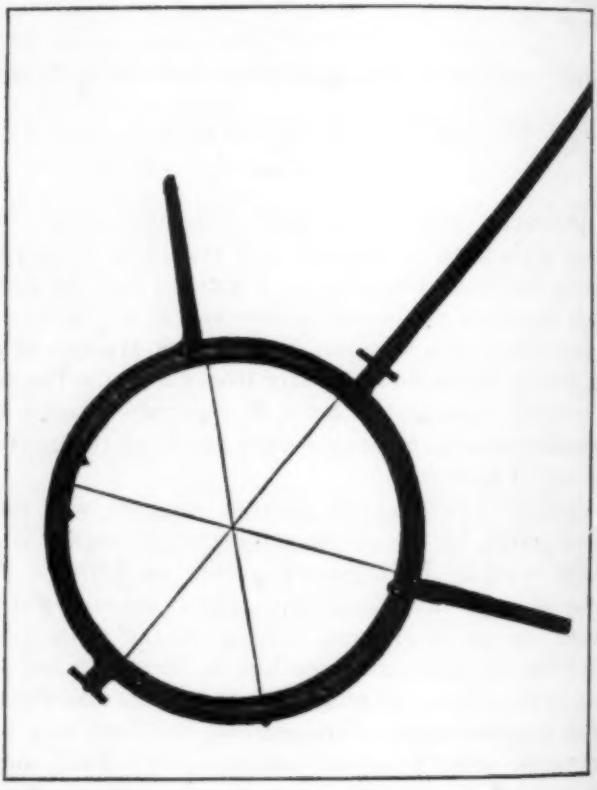
The instrument is a skeleton three-arm protractor, or station pointer, having the field of view free from the rim, arms, and hub of the ordinary type, and is therefore especially adapted for use on navigating charts; extension arms are fitted to the rims and may be used if necessary.

The method of locating the position occupied, with reference to known points, by use of the three-arm protractor is almost universally used by hydrographic surveyors, both on account of the rapidity of obtaining the result and its exceeding accuracy; navigators, on the other hand, seldom use the method because they find that the arms, rim, and hub so frequently cut out one or more of the objects as plotted on the chart, that the method is seldom practical without transferring the lines to a piece of tracing paper, or by graphical solution (Fry's Fix.), and these involve so much time, and are so objectionable on the bridge in the wind and weather, that the method is usually given up and the rougher method of compass bearings with the greater errors incident thereto adopted. This result has arisen from no fault of the method but from the inadaptability of the instrument by which the method is utilized.

Captain Lecky, in his well-known "Wrinkles in Practical Navigation," and many officers, particularly those having surveying experience, have, however, recommended the method to be used whenever possible.

HOW TO LOCATE POSITION WITH PROTRACTOR.

Select three visible objects which you know to be plotted on the chart, measure with a sextant the horizontal angle between the right and middle objects, an assistant at the same instant measuring the angle between the middle and left objects. These



angles are known as the right and left angles, respectively. Orient one ring to the right for the observed right angle and the other similarly to the left for the observed left angle. Move the protractor over the chart, keeping the center wire over the middle object until the right and left wires also pass over the right and left objects, respectively, being careful to keep the eye over the center of the instrument to avoid parallax. Mark with a pencil the intersection of the wires, which is the exact position of the ship.

With a little practice this operation will not take over a minute.

This method of locating a position is termed the "Three-point problem," also the "Problem of the two circles;" this latter is a misnomer, and it should be "The problem of the three arcs," as will be seen further on.

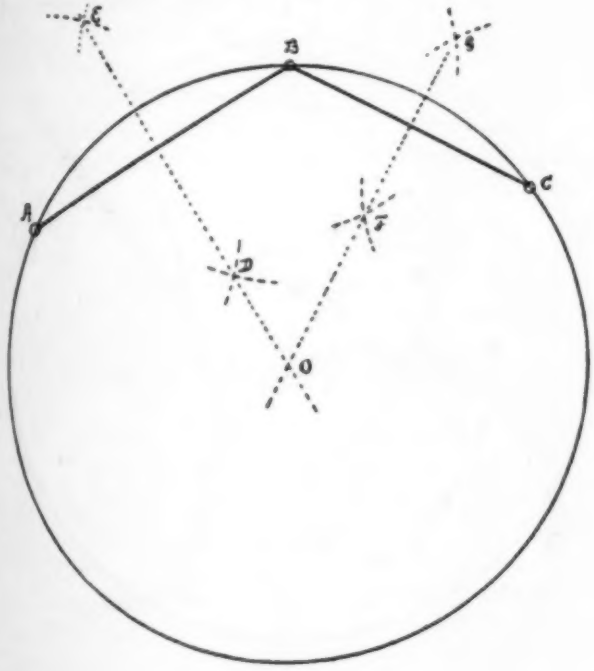


Fig. 1.

To understand the theory of the method it is necessary to note:

1st. That a circle, and only one, can be drawn through any three points.

2d. An arc of a circle can be drawn passing between two points so that the angular distance between them, when observed from any point on the arc, is equal to any given angle less than 180°; in other words, the arc is a line of position, from every point of which the angular distance between the points is equal to the observed angle.

Let *A*, *B* and *C* represent the points through which the circle is to be traced. Draw lines *A B* and *A C*, and erect perpendiculars to these lines at their middle points, the intersections of these perpendiculars at *O* is the center of the circle passing through the three points. When *A*, *B* and *C* lie on a straight line this may be considered as the arc of a circle of infinite radius.

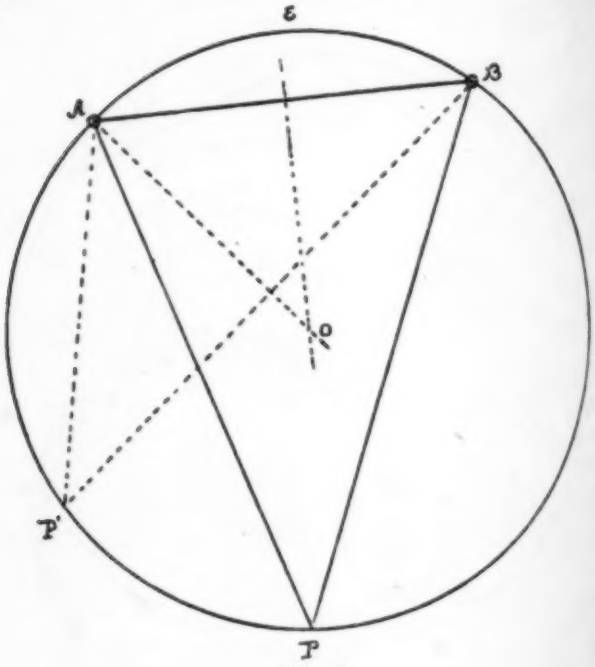


Fig. 2.

Let *A* and *B* be the two points and the angle observed between them is 40°. From *A* draw *A O*, so that the angle *B A O* equal 90°—40° equal 50°, and from the intersection of this line with the perpendicular to the middle point of *A B*, as a center, sweep a circle through *A* and *B*. It will be seen that the angle *A P B*, *P* being any point of the arc *A P B*, is measured by one-half the arc *A E B*, and equal to 40° and the observer must have been at some point of the arc *A P B*, at the instant of observation.

If at the same instant of time the angle between *B* and *C* was

observed (see Fig. 3), a similar arc *B S C* can be drawn, so that from every point on the arc the angle between *B* and *C* equals the observed angle; and the observer therefore must have been at *S* the intersections of these arcs, the only position from which he could have obtained the two angles at the same instant.

Now by adding the observed angles (*a*) and (*b*) together it will be noted that the observer must also lie on some point of the arc *A S C*, for from every point of this arc the angle between *C* and *A* equals (*a*) + (*b*), so we have a third arc of position.

It is not necessary to consider this arc of position unless the intersection of the arcs of position *A S B* and *B S C* are very acute, in which case many people conclude that the selections

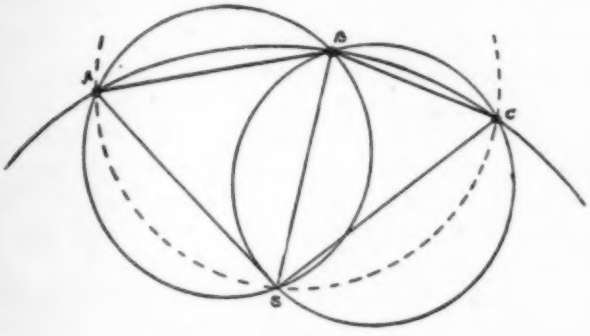


Fig. 3.

of positions, which may have been the only ones available, was not suitable, and would result in a poor "fix," while considering the intersection of the arc *A S C*, with either the arcs *A S B* and *B S C*, the fix may be shown to be an excellent one. (See position s_1, Fig. 4.)

The only times when the position occupied cannot be accurately located with the protractor is when the objects have been selected such that:

1st. Both the right and left angles are small.

2d. Two of the objects are approximately equal distances away, and the angle between them is small.

3d. The position occupied is on or near the circle passing through the three points.

A glance at the objects will enable one to avoid the first and second conditions, and other objects should be selected. One

angle may be small or even zero, provided one of the objects is much further away than the other. (See positions s_5 and s_6 in Fig. 4.)

The third condition is not so easily noted, though a little experience and a glance at the chart will usually prevent such an unfortunate selection of objects. Should the objects have been selected which would result in giving bad conditions, this fact will almost surely be noted in plotting the position by the

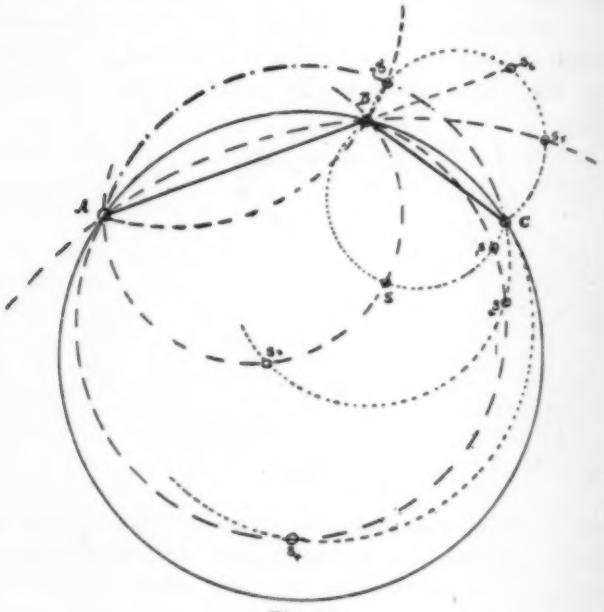


Fig. 4.

great difficulty in getting the objects accurately covered by the wires. Such a position is termed a "revolver." Cases may arise when there are no other objects available, in which case a compass bearing can be taken of one of the objects and the position plotted on this bearing. The term "near the circle" is relative to the distance to the nearest object. The conditions are always good so long as *the radial distance to the circle passing through the three objects is greater than two-thirds the distance to the nearest object.*

By noticing the angle of intersection of the arcs of position

in Fig. 4, the accuracy of the location under various conditions may be judged, and objects should be selected such that the arcs of position will intersect at as great an angle as possible.

It is excellent practice for the beginner to assume three objects as in Fig. 4, and then to assume the ship to be located at various points and notice by the eye alone how the arcs would intersect.

When selecting objects endeavor to use those which are most sharply plotted on chart, such as lighthouses, beacons, sharp peaks, small islets and rocks. Avoid tangents as much as possible, particularly if low and there is tidal range.

Frequently the angle between two of the objects is too great to be measured by the sextant, in this case a "split" can be taken on any intervening object, whether located on chart or not, the two portions of the split angle being added together for the right or left angle, as the case may be.

The protractor will be found most useful also in picking off the "danger angle" from the chart. There has been far too little attention paid to the "danger angle" as a result of the instruments usually not being on hand to easily measure the angle and the danger circles not being worked out and plotted on the charts so that the attention of the navigator is called to them, and aids to navigation as a rule being laid down without any idea of utilizing the danger circles.

The navigator will find upon examination of almost every chart that arcs can be drawn which will enclose many of the dangers to navigation, as plotted on the chart, and in many cases it will be found that an arc of large radius can be drawn, passing through the center of the channel, and by laying the course on the arc safety can be obtained whether the buoys are placed or not. Practice will show that it is almost as easy to steer the ship over the arc as it is to run down a range when the wheel is so placed that the helmsman cannot see the range.

The protractor is particularly adapted for use in chart drafting rooms for locating additions and corrections to finished charts.

In case a wire becomes broken, or stretched beyond its elastic limit, it can easily be replaced by melting the solder out of the grooves holding the wire, inserting a new wire and resoldering. Spare wires accompany the box, but in case there are none at hand, a banjo third, or mandolin E string may be used.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

OPENING ADDRESS DELIVERED BY THE PRESIDENT OF WAR COLLEGE, JUNE 4, 1902.*

By CAPTAIN FRENCH E. CHADWICK, U. S. Navy.

It is the natural tendency of man to accept the rut into which his life has run and plod along in it with as little deviation as possible. We generally call this conservatism. Of all professions, navies are said to have this attribute more completely developed than any other. I think this is true, and it is so for several good reasons. On the sea, men formerly came face to face with the mighty forces of nature as part of their daily life in a way in which no others did. It was not a problem of mechanics, of manufacture or agriculture, it was a question of dominating by the crudest appliances the powers of nature as exhibited in the wind and waves. Their life was along certain very definite and simple lines, and thus naturally took on a stereotyped form. Guns came and existed for hundreds of years in the simple form which most of us remember well; steam followed, then the great change in material of all kinds until the whole structure of the ship to-day and its armament and motive power are as different almost as is conceivable from the ship of much less than a century since. But this change, though decreasing to some degree our conservatism by removing us from the intimate relations with nature's forces which marked the old Navy, has left enough of the special influence of the sea to cause the naval man to be essentially differentiated from his fellows in his way of looking at life. No other classes

*Owing to the fact that the manuscript of this address was received when the rest of the number had gone to press, the address had to be placed as the last article of this number of the PROCEEDINGS.

of men unless it be the religious orders, are subjected to the attrition of a life of such close companionship dominated by a system of severest disciplinary regulations and by traditions which are even stronger than regulations.

The unquestioning obedience, the sense of duty, the methodical habits of an unvarying routine, the restriction when afloat to a society every member of which is cast in the same mould, necessarily sets an iron impress upon the character of the naval man, and makes him the pattern of conservatism which he is.

And one thing that marks our conservatism, is the very little that men of the sea have had to do with the changes I have just mentioned. They did not invent or bring forward the steam engine; in fact they opposed it; they did not invent screw propulsion; they had nothing to do with proposing iron and steel instead of wood. Our guns and gun mounts, our torpedoes, are all the products, as far as original invention goes, of the non-seafaring man; of the Watts, the Fultons, the Armstrongs, the Vavasseurs, the Ericssons, the Maxims, the Whiteheads. There have, of course, been inventors among sea-farers, but they have worked in the great lines which greater inventors have laid out for them.

It is just as well that this should be so. The officers of the Navy have too much to do to invent. Their daily life is filled to overflowing with a pressure of duties, such as it seems to me, can fall to no other class of men. They are seamen, soldiers, steam engineers, ordnance experts, electricians, astronomers, drill masters, house keepers and international lawyers. This certainly is a multiplicity of duties, and one has to be a good deal of each to be a successful officer. I thus do not think we should wonder that the naval officer, except in a mild way, is not an inventor.

But there is much more with which he is concerned, and this is the great field of administration, beginning with the bureaus of the Navy Department, and ending with ordnance factories, navy yards, and finally the administration of the ship and squadron.

Administration is a large question. It means the formulation and exercise of such rules as will cause the official machine to work most successfully. It is, in fact, when applied to Government, the largest and most important of subjects. The

divisions of our naval departmental system are too well known for me to enter into detail, but it may not be recognized, even by many officers, how much this system has changed, and for the better, in the last few years. There has been a gradual convergence to basic logical principles, whereby we have separated personnel, materiel and finance, the three fundamental divisions into which every naval department should be divided, but the necessity for which it took us many years to recognize. With the word "personnel" should be linked the word "command." It has taken us more than a hundred years to arrive at the point of concentrating the supply of officers and men, their control ashore and their management when in ships afloat, under one bureau. This is now practically complete, but there is still a slight change necessary to make it complete, which must come in time. Logic must have its way in the long run.

Concurrent with this change have come certain growths, unknown to the earlier Navy; the establishment in 1882 of an Office of Naval Intelligence for the collection of information; in 1884 of the Naval War College for the study of war; and in 1900 of the General Board. Few changes, though it may not so appear on the surface, have been more important. The first was a necessity to the rebuilding of the Navy. Without the information gathered by it, we should not have been in the position to build as we have built. Memory is short, and among the things forgotten is perhaps the fact that when the Dolphin was built in 1884 there was no establishment in this country which could make a steel shaft for even so small a ship. It had to be forged of iron. Tests were unknown then to us in general practice, and when Admiral Simpson, who was on board during her trial asked regarding this, the builders said the name of the maker was a sufficient guaranty. As the shaft broke on the trial and the board spent thirty-six hours at sea on bread and cheese as sole provender, it is to be presumed the members had another opinion of the firm that supplied the shaft from that held by the builders of the ship. At this same time we were supplying the engines of the Atlanta, Boston and Chicago since replaced. This fact of itself is a measure of our backwardness at the time. Abroad, the triple expansion engine with less than half the weight per horse power developed per ton of machinery, was at this moment in use.

The Office of Naval Intelligence supplied information covering the whole field of naval progress, from tests of steel (against the high character of which I may say our manufacturers of the period protested vigorously but vainly), to plans of ships, engines, guns and gun mounts, which Mr. Whitney had the wise courage to buy from the most advanced builders. In 1884 and 1885 we were buying our gun material and our armor plates abroad. In his report for 1886 the Secretary of the Navy, Mr. Whitney, said: "It is certainly a most lamentable circumstance that a country like ours, with its immense products of iron and steel, should be content to be dependent upon the manufacturers of any other nation for the fabrication of armor and high powered guns." A year later, December, 1887, he said: "When the last annual report of the Department was made, this country lacked three manufactories necessary to the construction and armament of a modern war vessel, viz.: that of steel forgings for the heavier guns, that of armor for iron-clad vessels, and that of the secondary batteries (machine and rapid-fire guns), an essential portion of the armament. Now all three manufactories are in process of construction under contracts with the Department." I think the Navy should remember that this change was the work of naval officers and largely the work done through and by the Office of Naval Intelligence, which has been a force in upbuilding the Service which has not been fully appreciated.

The establishment of the War College was the second of the steps in an unaccustomed direction which has worked a change and will work a greater one as part of the General Staff system which it forms with the General Board and Office of Naval Intelligence. It is too late in the day to discuss the propriety of a General Staff in any military organization. Any one who reads the literature of his profession, however slightly, knows that it was the perfection of the General Staff organization of Germany under Moltke, which gave the deadly blow to the Austrian Empire in 1866, and four years later overwhelmed and dismembered France. Germany became triumphant Germany through this work. Are we to ignore its effect? To do so would be to ignore every lesson of experience, of which this is one of the greatest.

I would quote here from my address of last year:

"If study and experience are necessary in banking, in admin-

istering a governmental department, or a great system of railways, it is naturally the part of wisdom to suppose that they may be good, in fact, necessary, in this business of war, which is so much greater than any which can fall to our civilian brother. It would seem that the statement should be axiomatic, but the great mass of military men are unquestionably loath to accept it in practice. However willing they may be, if pinned down to the point to admit the truth of what is just said, their habit, at least in general, is to allow it no weight whatever. We usually go on in the routine of the service, doing what comes to our hands to do, hoping that when the time comes to beat an enemy, we shall be ready and able to do so by the gift of God which comes to us by steady advancement through the grades of the service.

"But all experience is against this; there have been certain great masters in our profession, some half-dozen of the foremost rank; and though we do not know overmuch of the views and habits of study of most, we know very thoroughly those of Napoleon, the greatest of them all; and no one can be more emphatic in regard to the value of the study of the work of those who had preceded him; and there is no question that he himself was a most diligent student, genius as he was. If such a man thinks study necessary, how much more needful is it for those who are not geniuses, and who must, therefore, depend upon the principles which govern our business. For there are such principles. War is not a haphazard game any more than the great game of commerce. It requires the study of conditions, means, appliances, and, above all, that study of lines and bases of operation which is known as strategy. The first complete and methodic dealing with this great subject was the epoch-making work of Jomini, which has become a classic and which, though it has had many successors, still stands in the front rank.

"When we look over the field covered by the art of war, as tabulated by Jomini, I think there is no one who will say that there is no place or need in our profession for a college for the particular study of war as an art. He divides this into six distinct parts:

1. Statesmanship in its relation to war.

2. Strategy, or the art of properly directing masses upon the theatre of war, either for defence or invasion.

3. Grand Tactics.
4. Logistics, or the art of moving armies.
5. Engineering—the attack and defence of fortifications.
6. Minor tactics.

"Though Jomini only touches upon maritime affairs, 'to be taken,' as he says, 'in connection with maxims of descents,' his treatment of his main subject applies to fleets as well as armies. The fleet is simply an army moving with much greater rapidity than land forces. Its supply and maintenance involve the same considerations, and it is extraordinary that so great and original a mind as that of Jomini should not have grasped the more essential facts connected with command of the sea. It is the great pride of this college that it was the instrument of bringing before the world the views now accepted by all, of the overpowering influence of the army of the sea as contrasted with that of the army of the land. It was the great mind of Mahan which accomplished this revolution, giving sea power its logical supremacy in the minds of men which we can now all see it has always had in actuality. Had this college never had any further outcome; had it stopped with this result alone, its establishment would have been justified many times over. Mahan's work in giving naval power its just due has had a revolutionizing effect in international policies. It is not too much to say that no event in the latter half of the nineteenth century did more to direct the world of statesmanship into new lines of thought than these great works of an officer of our navy, and I do not think the weight which this college had in directing his own thought, and in the production of his great works which were first produced as lectures before the college, and as the natural outcome of his duties here, should be lost sight of.

"An important field of work for the college is always that of battle tactics, to which we cannot give too much thought and study. The development of the musket and of the field of artillery; the development of heavy guns and of the torpedo have caused both armies and navies to go about their ends in a very different manner from that of fifty and one hundred years ago. The principles remain the same but the methods must differ, and the land and sea forces of the whole world are now studying this vital question. That it may take some time to develop these to perfection is not improbable, but we may hope

that it will not take the centuries that were needed for the development of tactics under sail.

"For a hundred years previous to the appearance of Clerk's work on Tactics in 1779, all actions between the French and the English were of a very indecisive character. Rodney made a first application of Clerk's principles in his action with de Grasse. The final and successful tactics under sail were thus worked out in the solitude of a student's study, though there were hundreds of officers at sea to develop views, and scores of battleships with which to test them. This is an extraordinary fact and one which should not be lost sight of when the value of a place of study such as this is discussed; and I thus believe it is here where the questions of tactics will be finally solved, because it will probably be here that some active-minded genius will have the time and opportunity for thought and study which one so rarely gets at sea. England, at the period of the publication of Clerk's tactics, had few officers who made an independent study of either tactics or strategy, and to this fact is clearly due a failure which made certain the loss to her of the American colonies. Had Rodney not gone home on leave just at the time he did, it is beyond question that, with the opinions and views held by him, de Grasse would have failed to support Washington and Rochambeau; Cornwallis would have been relieved, the Yorktown expedition would have failed, and the consequences would probably have been fatal to the American cause. Rodney left orders covering the eventualities, but they were not obeyed. Admiral Graves, with faint conception of the enormous importance of his influence upon the situation, failed after his action with de Grasse to enter the Chesapeake, which, if he had done, would have prevented de Grasse from re-entering and would have prevented the reception by the allied forces of the siege train sent with the squadron of Barras from Newport. The result was one of the great turning points in the history of the world. This incident is mentioned merely as one of many to illustrate the fact that we cannot ignore preliminary study of strategic questions; that there must be a general study of these in order that we should not be at the mercy of chance as to whether the commander-in-chief has thought or not.

"If we do not have this general study the chances are that he will not have thought, and even if he be a man such as Rodney, it

is far better that he should have the aid of many minds instead of standing alone and unassisted. The united and long-continued study and thought of a large group of men are of more value than the off-hand thought of any one man of like mental calibre, and it is on this principle we have, in some countries at least, a general staff and places of study for such a staff akin in some degrees to this.

"In the face of the mighty results of the system it is vain to decry such studies. The other great military powers of Europe had, of course, some such organization, but none had the complete and flexible system of Germany. France began fair, but in 1832 the system of return of staff officers to the line was given up, and the staff naturally stiffened into the unwholesome and unprogressive routine inseparable from the continued occupancy of directive posts. There can be no surer road to inefficiency, not that it is down hill, but that it ceases to ascend, and we had the natural results when the two systems were pitted against each other in 1870.

"Administrative reforms with us work slowly. The Naval Academy had to be forced upon the service. I myself was on duty there with an officer (and it was only twenty-six years ago) who, when he took up the duty of superintendent, was an utter disbeliever in its utility. I had this from his own lips, when he assured me, however, that he had now seen enough of it to change his mind. We have been more than a hundred years in bringing about the establishment in the navy department of a bureau of personnel, thus gathering into one section of the department nearly, but not quite as yet, all things military, and we have been more than a hundred years in establishing a general staff, which I hope is now accomplished in the triune organization of the General board, the War College and the Intelligence office. For the great province of this college is not so much in the work of the summer's course as its studies in general staff work, with which, of course, the summer's work on the general problem is in line.

"The intelligence office is our collector of information, very much of which does not apply to military study; the War College is the collator of such information on military subjects, whatever its origin, which has a bearing on questions of war. It is in nowise a teaching establishment in the ordinary sense of

the term. It is a place for the study and discussion of military problems; for the study of war in all its phases, historical, strategical, tactical; of the events which lead up to war; of international situations, and of the probabilities or possibilities which might arise therefrom. Besides carrying on the study of such questions as continuously as its limited staff will allow, it prepares and lays before the General board such studies as may be particularly called for. The aim, however, is to prepare in connection with the General board, studies for all eventualities, so that the Department may be able to furnish a commander-in-chief in war with complete studies of the theatre of war; with thought made to hand, so to speak, and enable him to act unhampered by the necessity of forming a judgment off-hand regarding a great variety of questions on which hasty judgment cannot be safely made.

"I should like to quote here some words of Admiral Taylor's taken from his 'Memorandum on a General Staff for the Navy,' which appeared in the PROCEEDINGS OF THE INSTITUTE of September last. After speaking of the real functions of the general staff of an army or navy, he says:

"'The second element, though rarely recognized in a formal manner, is by far the more important of the two. It is the mental training of officers engaged in this plan-making, and their consequent readiness to confront warlike situations in general. It does not equal the school of actual war, but it is only second to it—and there is no third method. This trained readiness of officers' minds, in the Franco-Prussian war of 1870, constituted the essential value of the diligent staff work done by the Germans during fifty years of peace. What the world at large saw were the plans of work perfected in all minutiæ, railroad cars numbered for special work, arriving near battleships on schedule time bringing guns or men, pontoons or hospital beds. This it was which, being so admitted, gave to the staff its reputation among non-professional people, as it was, in fact, a most valuable aid in the battle and campaign; but far greater, as a factor of efficiency, was the state of mind of German officers—from generals down to majors—that familiarity with war situations, acquired in the staff work of peace, which enabled them to confront all emergencies of the campaign with ready energy and composure of mind.'"

To continue anew: We have, it seems to me, arrived at the desideratum advocated even so late as April of this year by a prominent English writer on military matters in the National Review, Mr. Spenser Wilkinson. In this article called "Preparation for War," he says that according to his conception the responsibility of the First Lord of the Admiralty covers three points. He is jointly responsible with his colleagues of the Cabinet on the whole policy of the government, and it is therefore his duty to agree to no act of policy whatever which would cause annoyance to a possible enemy unless and until his department is fully prepared for all the possible consequences of such annoyance. This involves a second duty; to be always prepared with a plan of war, and a third which is to assure himself that everything needed for the execution of his plan is in fact at his disposal. He continues: "No minister will veto political action proposed by his colleagues on the basis of a strategical judgment of the soundness of which he is not absolutely convinced. Yet the organization of the navy makes very little provision for supplying the First Lord of the Admiralty with sound strategic advice. The First Sea Lord is supposed to fulfill this function, but as far as can be known to outsiders, there have never been arrangements for giving any strategical training to persons likely to become First Sea Lords, and there is no reason to suppose that any kind of test of strategical ability has ever been required to be fulfilled by any First Sea Lord as a condition of his appointment. Moreover the system lays upon the First Sea Lord so many other duties that he cannot possibly concentrate his energies upon strategical problems. A First Lord of the Admiralty who was resolved to fulfill the three duties above mentioned could with sufficient determination, in a few years provide himself with the means of fulfilling them. He would begin by forming in the Admiralty, under the immediate supervision of his First Sea Lord, a Bureau of Naval Operations, subdivided into a history division, an information division and a division for operations proper. To this bureau he would entrust the framing of all orders for the movements of ships and fleets, and he would take means to select for appointments to it all those officers who revealed special qualifications for the higher branches of naval warfare. In this way he would prepare the systematization of strategical

knowledge. At the same time he would make competence in the general direction of operations the sole criterion in the choice of the First Sea Lord, and he would not rest until he had acquired in this bureau and in its chief a confidence sufficient to justify his staking his political existence by representing in the Cabinet the strategical conclusions at which they had arrived."

Change the words "First Lord" to "Secretary of the Navy," "First Sea Lord" to "Chief of Bureau of Navigation," and "Bureau of Operations" to "General Board," and we have described by this English writer exactly that at which we have arrived as far as war preparation is concerned. But the scope of the system he proposes should be extended. It should be arranged that in time no officer should go in command of a squadron and no officer should go on the staff of a commander of a squadron until he has had such connection with General Staff work as would make him fully conversant with such work and place him in sympathetic relations with it. This is not original with myself, I can say that it is the view long since expressed by the distinguished officer who is now Chief of the Bureau under which all such work comes and who is so completely, by his training and endowments the character which the author referred to as desirable to have as First Sea Lord of the British Admiralty.

The field of the College is a broad one and concerns itself, besides the actual study of war problems, with all that goes to make of the officer a student in the great addenda of his profession, diplomacy and international law and in the philosophic phases of military and naval history. No officer can afford to be without knowledge of the greater campaigns, both military and naval, and of what we may call world policies. The wars of Carthage and Rome, as Mahan has shown, are full of lessons to the naval man. Napoleon's campaigns in Italy, though dealing with army events alone, are of the highest value to us from the point of view of strategy. Our own Revolutionary War is a great naval study in itself; and its diplomacy, the negotiation of peace which followed, the attitude of the several powers concerned thereafter, our extension to the south and west, our relations for the next fifty years with European powers are studies of the highest moment for every officer of the Navy who aims to take high rank in his profession.

But it is not only the past we want to study. Such knowledge is chiefly valuable as a basis for action in the future; the one is the field of contemplation, the other and more practical one, is of action. To know how to act we must, to the knowledge of how those have acted under given circumstances, add the knowledge of the world of the day in which we live, and study whither it is tending. The immensity of the subject is staggering, but it has to be faced, unless we are willing to deal blindly with things. Man is developing his energies in ways and directions of which our fathers either knew nothing or had but faintest glimmerings. The alliance of coal and the steam engine gave him his first great impulse a century since, and he has gone on with an acceleration of movement which has surpassed the imagination of even forty years ago. It is for us of this generation to consider whither this great human movement is to carry us, and how we shall prepare ourselves for the part we are to play in it.

First, we have all become neighbors. There is no more distance. The telegraph has brought the Emperor of China into the same room with the President of the United States; it is only that they talk through the curtain. Steam moves troops in weeks or even days over distances where it once took months. Napoleon took from June 14 to September 14 to go from the borders of Russia to Moscow, though in this time he met with no real check. Armies before the days of railways could not be moved more than twelve miles a day. Fleets took many weeks to cross the Atlantic; whence d'Estaing's failure in 1778 to blockade the British fleet in the Delaware and to capture New York. We thus deal with much shorter intervals of time and with immensely greater forces of every kind. The whole question of war has become one of great complexity in which we must think more quickly and certainly. There is no time now, after war breaks out to make plans and other preparations. Other things equal, victory will be to the man who, to use the vernacular, "gets there first." Thus what is doing by the rest of the world; its preparations, its aspirations, its designs, are to us as naval men subjects of the deepest importance.

And there is much in the word "aspirations." There are some great aspiring races which have still within them much of the primitive energy, such as that with which the Barbarians

over-ran the Roman Empire. The great races of the Mediterranean would appear, if reckoned by their increase in population to be losing ground. It is not amiss to take as a fair measure of the future power of a race, other things being equal, its rate of increase, and so measured by taking the difference between births and deaths we find France stationary, and Spain increasing at the rate of only 4.3 per thousand. Italy 9.6. On the other hand the people of the United Kingdom are increasing at the rate of 11 per thousand, while those of the German Empire are increasing at 14 per thousand, and of Russia at about 14. All the Slav states show this very high rate of increase or even greater.* It thus becomes a mere question of time when, if numbers only shall be considered, the white races to be reckoned with as striving for supremacy will be the Slav, the Teuton and the great offshoot of the latter, the Anglo-Saxon. Shall they expand as they please; can they expand without wars; shall one dominate the others, or shall Christianity become such a force that it shall make no difference to any man whether he lives under the administration of Russia, Germany, Great Britain, the United States or China? I venture to say that such altruism will not come in the days of most of us; that we must look forward to dealing still with those primitive passions which show so little sign of abatement; the fierce thirst of gain, the pushing of this race or that to the wall in the contest for commercial supremacy which has been at the bottom of most wars in the past and will be the chief, if not almost the only cause in the future. If history has taught anything it is that strife for the control of commerce is the great war-producing

*NOTE.—This important question is complicated by the varying conditions of sanitation in the several countries. The birth-rate of Great Britain, for example, (about 29 per thousand) is low compared with that of Russia, about 48; German Empire 36; Austria-Hungary 37; Italy 35; Spain 36. But the death-rates of these latter are correspondingly high. While in Great Britain it is but 18 per thousand, it is in Russia 34; German Empire 22; Austria-Hungary 25; Italy 23; Spain 31. France in 1898 had 22.1 births and 22.1 deaths to the thousand. In the United States between 1890 and 1900 the average annual increase in native population was 17.4 per thousand; the death-rate is estimated to be about the same. This would make a necessary birth-rate of about 35 per thousand in order to produce the increase in native population mentioned. The data of the Census do not afford an absolutely accurate determination, chiefly through defective laws in many of the states.

factor; that nations fight that they may sell, and we are coming to be faced, as never before, with the difficulties which, as well as the benefits, may be involved in commercial expansion. Our commercial and manufacturing success carries with it a commensurate responsibility. Every phase of life has its compensation, and the nation which grows rich, which expands its trade, which undersells its neighbor must prepare to defend its prosperity much as does the prosperous bank with its steel bars and armed watchmen. It is a law which none can evade.

While the Slav, the German and some others have a larger birth-rate than the Anglo-Saxon, the increase is offset by the smaller death-rates among the latter and by the absorption of so many of all races into the great branch of the latter in America which absorbs and stamps through its language, laws and literature, its own character upon the many thousands who migrate to us and who form so great a percentage of our own increase. The people possessing the United States are thus destined to form one of the great world powers in numbers alone. But it will not only have the influence of numbers, it will have the mighty influence of the coal and oil it owns in greater quantity and in better quality than the rest of the world, and it is this factor which must give it an unapproachable manufacturing supremacy and power. With unlimited coal at but a small proportion of the cost at the mine's mouth of that of Germany, for example, and with the constantly decreasing and more difficult supply in Europe, there can be no question that under the impulse of conditions, we are tending to be the great manufacturing power of the world.

To understand the importance, the immense importance, of our coal fields we must recognize the fact that upon coal and the lesser fuel, oil, depends the whole of modern civilization. The use of coal bred the steam engine through the necessity of keeping the mines clear of water, and it is the multiplication of energy by the use of the two which made human advance in the last century so wonderful and which carries on this advance with constantly quickening pace. 1800 may be taken as a dividing line, on one side of which lie untold thousands of years during which man slowly developed his mechanical ability and on the other the wonderful one hundred just passed. The latter years have carried us into another

world, all through the influence of coal the importance of which has become such that even imagination cannot exaggerate it. One may say that the combustion of 300 pounds of coal is equivalent to the labor of one man for a year; that if we allow but one-fifth the coal produced in this country to be used in motive power, it represents an addition to the labor of the United States of over 300,000,000 men who have neither to be clothed nor fed; that this is about equal to the entire population of Europe, about four times our own population, and about forty times the number of persons employed in manufactures in the United States; that in other words, our laboring capacity is at least forty times what it would have been had the conditions of the eighteenth century been continued. But the difference is infinitely greater. We must consider the results of the applications of this energy. We can say that the power of the steamship Oceanic, for instance, represents the energy of 250,000 men, but as at least three shifts of men would be needed to exert this power continuously, it would take 750,000 men to do the work which is done by the coal burned in her boilers. But the fact, of course, is that they could not do it at all any more than they could drag an express train 60 miles an hour. The ratio is really infinite and we can truly say that no number of men could do the world's work of to-day! It is done by coal and so far as we can now see it must continue to be so done.

Such thoughts lead us far. Linking them with the fact that we have an area of coal fields, already discovered, about five times those of Europe; that our coal is of much better quality than any European continental coal; that the cost of mining in Europe is constantly increasing through deepening mines, whilst ours at the pit's mouth is absurdly cheap, we can easily see the mighty force which we have to develop and control. Whither it will carry us is beyond our ken, but that is the greater reason for study. Along with the immense fact that the Slav, the Teuton and the Anglo-Saxon are the great increasing races of the world, is the almost more important one that they are the chief coal and oil owners. Italy has no coal whatever, Spain an area of but 2800 square miles, and France and Belgium but 2500; Austria-Hungary but 1800. The only coal fields which, from our present knowledge, can offer possible rivalry to the fields of the United States are those of Australia and

China, and we can venture to predict that it will be over these Chinese fields and the development of their potentialities that the future struggle for supremacy in Eastern Asia will take place, unless China herself shall show an unexpected ability to control and defend these interests.

It would seem a necessary corollary to what has been said that the countries of southern Europe, unless they become more prolific and find an increased coal supply or a substitute for it, must with time fall behind as wealth-producing powers in comparison with the prolific and coal-owning races. Can it be otherwise if the latter shall have the overpowering numbers and the principal basis of mechanical energy? And wealth is the synonym of power. And as we have come to see that it is commercial interests which rule and not the mere dicta of governments, we can readily see that the chief dangers to the world's peace will probably lie in the conflicting interests of these great prolific races and coal owners. In these conflicts of interest there is a potentiality of antagonisms of momentous character.

These are questions which deeply affect the Navy. In saying this I do not mean to say that we must necessarily look forward to a certainty of war, within any near period, but our duty is to be prepared without regard to time.

I know that there are many who will deride such a view but I venture to say that they are those of short memories and of little philosophy. To such I would recall the fact that a gentleman high in administration in 1897 stated publicly that the officers then in the navy would never see a war; that another able administrator said the same to myself shortly after leaving his post in the Navy Department. These were but the expressions of a very general feeling, the like of which I might multiply to any extent. We and they know how mistaken they were, and how these views were falsified in the one instance in a few years, and in the other in a few months. It is such shortsightedness, which the broader-minded statesman; which naval men, who are by their profession students of the history of wars, have to combat. Within my own lifetime we have had four wars; the Mexican, the Civil, the once chronic Indian and the Spanish, besides the operations in the Philippines and China. And though taking the view that wars must probably

come, the naval man is not their fomentor; he is, indeed, a pacificator, a maker for peace; and a powerful navy, a conservator of the world's peace. It is in this that the conservatism of the naval man shines with a noble lustre, and in this connection I may mention the high compliment to naval officers expressed in conversation with myself a few days since by the Secretary of State. He said he had been greatly impressed with the ability with which naval officers had handled the difficult international questions with which they had lately been charged in Central America; that they had made no mistakes and that he, personally, felt under much obligation for the manner in which they had conducted questions on that coast. As the Navy does not receive generally too many compliments I thought it would be pleasant to the Service to make known these words from one who has made so great a reputation in the diplomatic world by his conduct of the Department of State. The compliment, too, adds to the interest of the diplomatic and international law studies with which so very considerable a proportion of our time is taken up. You know the results of those of last year, which have added a volume which will have permanent place as authority. As much may be hoped for the outcome of the present summer, and the result must be in time, if continued with equal success, the establishment of the Naval War College as perhaps the foremost school of international law. With such men as Moore and Wilson as directors and expositors, and with men whose lives are spent in dealing with international law, as students, suggestors and critics, it is reasonable to hope and expect to reach the high place I have just mentioned.

But to return to the great question of war which faces us and must face us so long as man is what he is to-day. The mission of our country is, I hope, one of peace. I disdain the idea that the slaughter of war, the mere blood and thunder of our occupation, should be a matter of pride either to the man engaged in it or to his countrymen. I hold that he is the greatest commander who shall do by strategy what would otherwise have to be effected by brute force; and so, in line with this I hold that if we desire peace, the true strategy of the country is to assure this peace by commanding it, and we are great and rich enough and fortunately so strategically placed, as to be able,

if we desire, to do so. The old French proverb has it that "he who makes himself a sheep will be eaten by the wolves." The rôle of the sheep is not for us, nor is that of the wolf, but it is the dictum of merest common sense that we should see to it that our Navy shall be sufficiently powerful both in materiel and in the morale which comes from thorough mental and physical training, to make sure that no one shall venture to "molest or make us afraid"; so long as we follow the way we believe to be right.

It is thus our business to look forward, to consider what is likely to happen, to judge what is necessary from a naval standpoint to meet these happenings and finally how to meet them. All this is done and can only be done through a General Staff, of which this College is so important a part.

To epitomize, we may say that its duty is to study the past, make acquaintance with the present, and forecast and prepare for the future. This duty leads us into a world of study than which there is none more important in aim or result. The aim, if war has to come, is success; the result, if the aim be achieved, is the safeguarding of the nation; of its honor and well being.

DISCUSSION.

"A New Type of Battleship." See No. 101.

Captain W. M. Folger, U. S. Navy.—The battery of the armored ship proposed by Lieutenant Signor is a very powerful one. It is, however, believed that the recoil strains upon such a turret and the displacement of the latter (in arc) in firing would prove extremely disadvantageous. It is further believed that the small guns shown between the muzzles of the forward turret guns could not be successfully operated.

Professor P. R. Alger, U. S. Navy.—A thorough consideration of Lieutenant Signor's proposed design of battleship would require, first of all, a careful study of the weights to be carried in order to see whether the displacement which he reckons on is sufficient. I am of opinion that he has underestimated the armor weights which would be necessary for triple gun turrets such as he proposes, but, even supposing those estimates to be exact, such study as I have been able to give to the question has convinced me that all the conditions he has laid down could not be met on the stated displacement.

Comparing Lieutenant Signor's design with the Virginia as she was originally planned, his ordnance weights are the greater by 700 tons; his armor weights, exclusive of armored decks, are the greater by some 300 tons, while he proposes to put 1600 tons into armored decks as against about 1100 tons on the Virginia; and yet his displacement is but 775 tons greater than that of the Virginia when each ship carries 1000 tons of coal. It is true that the Virginia had 19,000 H. P. as against only 18,000 H. P. for the proposed ship, but this is allowed for in the estimate of engineers' weights.

I am afraid, therefore, that only radical improvements in marine engineering, bringing about a great reduction in the weights of boilers and propelling machinery; or the use of improved material for ship construction, making a large saving in hull weights, would enable the offensive and defensive features proposed by Lieutenant Signor to be embodied in a vessel of the dimensions he fixes.

If we admit, however, the entire practicability of the proposed battleship, the question then is, to what extent, if at all, she would possess superior offensive and defensive powers?

Considering armor distribution first, it seems to me that there is great waste of weight in covering the entire side, from bow to stern, with 6-inch armor, behind the greater part of which there is nothing of importance to protect. It would be far better to use the weight for putting the twelve 5-inch guns in separate armored compartments, either turrets or casemates, and for armoring other special parts, such as the uptakes, which in the proposed management are behind the 6-inch side armor. The use of 18 inches of armor for the heavy gun barbettes, while the turrets have only 8 inches on the sides and 4 inches at the

back, is also unwise, in my opinion. Not only are the barbettes covered by the 6-inch side armor, but their perforation by a projectile is far less likely to result in serious damage than a similar perforation of the turrets themselves would be.

It is the proposed armament, however, that, as the essayist himself says, presents the most important innovation. In the first place, he would substitute two turrets, each containing three 13-inch guns, for the turrets containing two 13-inch guns and having superposed 8-inch gun turrets of the Kearsarge class, on the grounds that a third large gun is of more value than a pair of 8-inch guns, and that better protection is thereby gained. Now it may well be that one 12-inch or 13-inch gun is *per se* better than two 8-inch guns on a battleship, but the comparison is by no means so simple as this—the question of interference of fire of one gun with another comes into play—a third 13-inch gun in a turret with two others is by no means the same thing as a 13-inch gun mounted by itself; nor, perhaps, is a pair of 8-inch guns in a superposed turret the equivalent of the same guns in a turret by themselves. This is a matter about which opinions differ widely, and which should be cleared up by experimental test. There are men whose judgment must be respected who claim that a gun mounted with another gun in a turret is not worth more than 75 per cent as much offensively, without considering at all the question of relative liability to damage, as if mounted by itself; and that putting two 13-inch and two 8-inch guns all in one structure, as close together as is necessary in the superposed turret system, will cause such a loss of rapidity and accuracy of fire as to make their offensive value no greater than that of one 13-inch gun and one 8-inch gun mounted singly. Personally, I consider this estimate very wide of the truth, though I admit that some loss of efficiency will always result from mounting guns in pairs, and still more from mounting them in threes or fours, but it is to be deplored that the experimental determination of the actual loss of efficiency is not made, as it readily could be.

When the question of relative protection is considered, I have some doubt of the correctness of Lieutenant Signor's opinion that the triple gun turret would afford a smaller target than the two-storied turret, and for equal weight would have better armor protection. The addition of a third 13-inch gun must increase the least diameter of an ordinary 13-inch gun turret more than 8 feet, since the 13-inch gun mounting actually occupies a space of that width; and, since the turret and barbette together are about 20 feet high, this would add about 160 square feet to the target area, while the target area of the 8-inch superposed turret is only about 118 square feet. Moreover, the use of a third 13-inch gun would add at least one-third to the weight of an ordinary turret installation for two 13-inch guns, and this must be a much greater increase of weight than the saving of weight which would result from removing the two 8-inch guns. The port plate, moreover, which must be relied upon to stand the brunt of attack, would have to be made in two pieces in the case of a three-gun turret, and would be correspondingly weakened, since the dimensions of the present port

plate for a two-gun turret cannot be much exceeded in manufacture. Actually I believe that a considerably greater increase of diameter than 8 feet would be necessary to allow the use of a third 13-inch gun, especially as guns with 2800 f. s. muzzle velocity are called for. This would require a much larger chamber than that of our present 13-inch gun, and a correspondingly greater diameter of breech.

Again, with two guns in a turret the breech mechanisms are made one left and the other right handed, but with a third gun in the middle space would have to be allowed for opening the breech to one side or the other, unless some new system of breech closure be used.

On the whole, I believe that, if the details of a triple gun turret were worked out, it would prove to have so many disadvantages as to far outweigh its advantages, even supposing that they exist to the full extent claimed.

Another feature of the proposed battery arrangement is the large arc over which the heavy guns are said to be able to fire. Unfortunately the extreme angles of train claimed are impossible of practical attainment, and if they were, would be equally as well attained by the batteries of ships of well-known design.

The necessity for living space and for the storage of boats fixes a limit to the allowable arc of fire of the forward and after turrets at about 270°, instead of the 300° and 315° claimed by Lieutenant Signor. And an even greater error is made when he assumes that his broadside turrets may safely fire from right ahead to right astern. At least 20° must be taken from the 180° train which he claims for these turrets, as firing within 10° of the line of the keel would certainly tear up the decks and wreck the superstructures. In this connection, too, it must be said that many of the 3-inch guns are so placed that men could not possibly stand up to work them while the heavy guns were being fired on account of the effects of the blast from the latter.

If the ordinary double gun turrets be used, instead of the triple gun turrets, then much can be said in favor of a main battery arranged as proposed by Lieutenant Signor, though I should prefer eight 12-inch guns to four 13-inch and four 10-inch. Only one turret would be able to fire right ahead or right astern, but three turrets would bear on each broadside, from bow to quarter, and two would command the arcs from about 10° to 45° on each bow and quarter. It must be understood that fire right astern is of little value and fire right ahead of even less value. The former may be important to a vessel being chased, but this is a condition not greatly to be considered in the design of a first-class battleship; the latter can only be of value when chasing, and then the enemy may as well be kept on the bow as right ahead, since superior speed must be assumed to make the chase effective in any case. Apparently it is not often noted that under conditions of actual fighting it would be impossible to hold an opponent right ahead for any considerable interval of time.

Two other suggestions in regard to ordnance are made by the essayist. One is that our projectiles should be made heavier, and the other that they should be formed with rounded bases to diminish air resistance.

Our present 5-inch shell is certainly too light, and the new 5-inch gun will fire a 60-pound projectile, but I doubt the advisability of making a 4-inch shell weigh 52 pounds as proposed. It must not be supposed that armor penetration depends only upon projectile energy—the projectile must be strong enough to penetrate the armor, and increase of length greatly reduces the strength of a projectile to resist rupture upon impact. If a 4-inch shell weighs 52 pounds, it must be nearly or quite solid to have strength enough, and even then would be about 5 calibers long. Our present projectiles were designed for use at moderate ranges, and, while the use of longer and longer fighting distances may make it desirable to somewhat increase their weights, I should doubt the wisdom of any radical change in that direction.

Finally, as regards the effects of a taper base upon the flight of projectiles, it would certainly seem worth while to test the matter experimentally. It is perfectly possible that the advantages would far outweigh the disadvantage of greater cost and difficulty in manufacture.

Naval Constructor D. W. TAYLOR, U. S. Navy.—I have examined with great interest Mr. Signor's proposed new type of battleship and must congratulate the author upon his display of the courage of his convictions.

While he explicitly states that his outline plan is not intended as a working design the detailed dimensions, characteristics and weights are put forward in the form of a complete design, and before taking up the individual features proposed by Mr. Signor, I think it necessary to say that in my opinion the combination of features shown is impracticable upon the displacement. The draught of the vessel is three feet greater than the draught which it was decided must not be exceeded by the battleships of the Kearsarge class, and two feet greater than the draught which was finally given to the 16,000-ton battleships recently recommended to Congress by the Navy Department. This question of draught is one of the most vital matters connected with the design of large battleships. Had our battleships designed in recent years been allowed to have a draught of 26½ feet at trial displacement and 28½ feet in deep-load condition they would have been different, and, in my opinion, decidedly better ships, but the sentiment of the sea-going officers of the navy is decidedly against such draughts, and they have had to be reduced accordingly.

The peculiar form forward recommended by the author is, in my opinion, about the worst form for speed that could be used. With this form there would be some difficulty in obtaining a speed of 18 knots with the horse-power proposed, though the actual speed which would be developed would probably not fall short very much. The proposed sustained sea speed of 16 knots would require very much better work than has yet been done on any of our ships. I do not believe there is a case in our service where one of these large vessels has maintained at sea for 48 hours anything like 60 odd per cent of her trial horse-power, and am inclined to think the instances are few and far between where as much as 40 per cent has been maintained for 48 hours. For this reason I consider the estimate of 16 knots maintained sea speed, which

would require the maintained development of over 11,000 H. P., impracticable.

With reference to the table of weights on page 8, the items down to and including fresh water for drinking (taking out the item of 1600 tons for armor decks) total up to 5620 tons. This is more than a thousand tons less than the corresponding items for the 16,000-ton battleship recommended to Congress by the Navy Department, and after making all possible allowances for the differences in dimensions and other features of the two ships, I am forced to conclude, apart from all questions of armor, battery, engineers' weights and coal, that the design as put forward is impossible upon the weights.

I might point out also that on a vessel 50 feet shorter than the vessel recommended by the Department, the author proposes to carry machinery for 18,000 H. P. instead of 16,500, and coal-bunkers with capacity for 2500 tons of coal instead of 2200. I am inclined to think that when the attempt is made with our allowances of space per I. H. P. for machinery to find space for this coal and machinery on a 400-foot battleship, to say nothing of the four submerged torpedo-tubes which the author appears to desire, but are not in the 450-foot ship, it would be found that something would have to go out.

In the sketch plans there is no indication of provision for stowing or handling boats. This is one of the very puzzling problems on all of our recent battleships, and with even an 8-inch waist turret firing from right ahead to right astern the difficulties of getting out boats are enormously increased. With a three-gun 10-inch turret amidships the problem becomes harder than ever to solve.

Considering now some of the features of design proposed by the author, I fully agree with him that the time is ripe for radical changes in the type of battleship design now current both with us and abroad. The development of high-explosive armor-piercing shell with a fuse which detonates the shell after penetration of armor necessitates, in my opinion, very serious changes of design. It is necessary to give better protection to all guns and make such modifications in the general distribution of protection as will minimize the damage from heavy high-explosive shell. The general idea of protection proposed by the author is very good as regards protection against high-explosive shell. There is no more satisfactory way of protecting a gun than to put it in a turret, and I think with the author that we should mount the gun where it is protected in the best possible manner, and if there are incidental objections to turret mounting we should get to work to overcome them or minimize them. In regard to the triple gun form of turret, I should anticipate the same difficulties, although to a somewhat less degree, as are encountered in the superposed turret. We have now had for some time two ships with superposed turrets but so far as I am aware there has been no serious endeavor to determine by exhaustive experiments the question of the amount of interference between the two turrets. It would be very easy to take a superposed turret and make sustained firing trials at a large-sized target which would fairly represent a ship. If the double turret is used first as an 8-inch turret only, second as a 13-inch turret only, and third as both simultaneously, it would seem

practicable to obtain in time a reasonably close approximation to the offensive advantages and disadvantages of the combination. This has been recommended and I am unable to understand why it has never been done. We are now building $30,000,000 worth of battleships with the superposed feature and within a year of finally adopting it for these battleships have rejected it again in our most recent designs.

In view of the author's statement on page 9, that a 10-inch gun will penetrate nearly all armor afloat up to 4000 yards' range with impact within 30 degrees of the normal, I am somewhat surprised at the combination of calibres which he recommends. It seems to me that the heaviest gun carried by a battleship should in every case be the smallest gun capable of penetrating with certainty the heaviest armor of an opponent. For angles of impact materially beyond the biting angle of shell it makes very little difference in the case of armor 6 or 7 inches thick whether the shell is 10-inch, 12-inch or 13-inch, it will fail to get through in any case. If then within the biting angle the 10-inch gun is able to get through any armor to which it will be opposed it would seem that a 10-inch gun ought to score more hits than a gun of larger calibre because it should certainly be fired more rapidly and perhaps more accurately. Then again on a given weight more 10-inch guns can be carried than 13-inch. While a single 13-inch hit will do more damage than a single 10-inch, I should think there is very little question that two 10-inch hits would certainly do more damage than one 13-inch. Moreover, if we suppose two battleships, A and B, A opposing, say, six 10-inch guns to four 13-inch guns of B, the chance of A getting home a heavy blow first is about double that of B, and it seems very desirable to get in the first heavy blow.

I am in entire sympathy with the ideas of the author that greater rapidity of fire should be aimed at with heavy guns, mechanical means being freely used for this purpose. I am willing to go even further and say that the apparatus for handling the guns should be so modified that the man who fires the heavy turret gun will be able to manipulate it as readily and effectively as the man who fires the shoulder gun. It would seem to be mechanically possible to have a heavy gun which can be kept on the target all the time. The electrical turning gear now fitted in our turrets allows this to be done in azimuth, and it would seem possible to put in powerful and quick-acting gear to raise or depress the gun faster than the ship rolls. It seems to me, however, that if the utmost rapidity of fire is aimed at, it will be necessary to have all ammunition fixed, that is, the shell and charge put up, manipulated and loaded as one. This will require ammunition, turrets, ammunition-handling devices and magazine arrangements radically different from any that we now have.

The very valuable feature recommended by the author of two heavy decks could not be adopted on our present battleships because of the great weight required. It is important to have some such feature, however, if the further protection made necessary by high-explosive shell is to be obtained. The only practical way of reaching this end that occurs to me is to reduce the freeboard at the ends of our ships. We cannot have everything and I believe that if we lower the freeboard

at the ends we can markedly increase the offensive power of our battleships in ordinary weather conditions and their defensive power under all conditions without reducing the offensive power in rough weather, and that the sea-going officers of the service should advocate instead of oppose a low freeboard at the ends. If comparatively slight changes are made in the vessels of the Indiana class forward they would be as dry as our higher freeboard ships, and yet I have been told by some officers that even as they are they seldom encounter weather conditions when they are more hampered by water coming on board than the higher freeboard ships. There are two sides to this question. While an additional deck forward requires the water to come much higher to get on board, it also seriously interferes with the speed with which the bow rises to the wave. Many officers consider that a change of a few feet in the position of a 10-ton anchor tends to make a ship bury herself forward. If the forward deck were taken off one of our battleships it means taking off bodily 100 tons or so.

The author rather seems to contemplate triple screws but is on the lookout for something more satisfactory than the reciprocating engine. I believe the steam turbine has now reached a stage of development which warrants its adoption for any man-of-war. I would fit on a battleship such as under consideration four turbine-driven screws. The alleged great disadvantage of turbines for men-of-war is their very poor economy at low speeds, since they rapidly lose steam economy as their speed of revolution is decreased. As a matter of fact a comparatively simple mechanical development will enable us to obtain as good steam economy at low speeds as at high speeds. I would make the propellers of adjustable pitch—a mechanical problem much easier to solve with a turbine engine than with a reciprocating engine—and then within the limits of all desirable cruising speeds the rotary speed of the turbine could be kept at that giving greatest steam economy. Making due allowance for the smaller propeller efficiency that must be put up with when high speeds of revolution are used the net result would, I believe, be appreciably greater economy at low speeds and about the same at top speeds as compared with reciprocating engines.

DISCUSSION.

"THE TRAINING-SHIP." See No. 101.

Captain F. E. CHADWICK, U. S. Navy.—It has been a pleasure to read Lieutenant Beach's excellent and thoughtful article. I cordially agree with his views; that is, that there should be an approximation to a uniform system of drills and instruction in use on all training-ships (not that there should be absolutely rigorous similarity, as I think individuality needs some scope in order to bring forward occasional changes); that everything be dropped out which can be omitted in the training-ship and greater thoroughness thereby obtained in that which for the moment lies at hand to do (I would drop out as much as possible those things which come to him in the way of routine after transfer to active service); and finally that the training-ship should be of moderate size. There is no question that better results will be got in the smaller ships.

As to the question of building vessels for training purposes only, we should remember that they are our naval gymnasia. If we would consider the great sums spent throughout the country in gymnasium buildings and for athletic exercises we would have a fairer perspective for our estimate of what we should do in the navy for such training. The whole Anglo-Saxon world is wedded to the view that athletics must be cultivated as a part of the young man's education at college as a character training. Why does not the same view apply at sea? In the one case it has no bearing upon the student's future except as a formation of character; in the other, it both forms the character and trains for the actual duties of the seaman. The training-ship is our gymnasium in a very large and actual sense.

Lieutenant Beach speaks of the "unsatisfactory per cent of the graduates of the training service who follow the navy as a calling." This only accentuates the fact that we should train the more. The true point of view is that the training service is a great national school, and furthermore it is far and away the best common school we have. The boy not only gets his good common school education, but he gets a character and disciplinary education, and an acquirement of valuable and handy knowledge which no other common school can attempt to give. There is no more valuable element of our society than the well-trained sailor man when he leaves the service. He has the qualities so much needed, particularly in a democracy where self-command and restraint are needed to a greater extent in the individual than in a country where these qualities are commanded by the policeman. With us the individual is largely his own policeman, and what we have to guard against is human nature run riot, because it has the chance to do so. We should recognize that after all the gentleman is merely the trained and disciplined man; trained and disciplined by environment of every kind, and this principle holds good throughout; it is only a question of degree.

The whole of the United States expend about $170,000,000 upon their common schools. Almost as much (about $140,000,000) are expended by

universities and colleges. The Federal Government expenditures for such purposes are absurdly small in comparison, and besides, it has for its expenditure an actual and concrete return of service, whereas the several States can, for the vast sum they expend, only hope that they may have a return in better citizenship.

I do not think that we can emphasize too strongly that the country at large gets a most excellent return for what is expended upon the training service of the navy. It is fortunate in having what it has; it would be more fortunate if the numbers were largely increased.

Captain CASPAR F. GOODRICH, U. S. Navy.—It is always gratifying to find that one's notions are shared by others and the gratification is heightened by the circumstance that the others look upon the same subject from a widely separated point of view. As we grow old in the service the suspicion gains upon us that, in some incomprehensible manner, the tools and ideas of the profession have so departed from our early conceptions that we stand in danger of becoming strangers in our own house. So much has indeed been written and spoken in derogation of the once-accepted doctrine, dear to the hearts of the older generation, that the man-of-war's man must, first of all, be a seaman, that to have this text expounded so ably and so enthusiastically by one of the younger generation is pleasing beyond expression. Surely our ancient faiths must have some claims to consideration and some importance in the navy court of public opinion when a young champion arises to do battle for it and shows, by his skill in attack and defense, that the cause is still alive and fresh, and capable of mustering its adherents in formidable array.

With what Lieutenant Beach has said I am in complete accord. We cannot, if we would, shirk the responsibility of training our apprentices, and we must, whether we will or no, prove our competence not by theory but by results. Formerly it was possible to draw seamen from the merchant marine and to turn them into men-of-war's men by the simple process of routine drills and exercises. That source of supply being shut off, how can we best replace it? Such I take it to be the real question at issue. And I accept Lieutenant Beach's answer as entirely adequate until a new combination of needs shall develop to call for new methods.

His emphasizing the characteristic of thoroughness in our training is especially timely. The curse of our modern schools, primary, grammar and high, is an extended curriculum which produces little real learning—which yields a specious and glittering smattering rather than a firm and complete grasp of a few things well done. Better I should say, omit three-quarters of the subjects undertaken and do full justice to those which remain.

There ought to be entire acceptance by the navy of the scheme proposed by the writer. Nothing so good as the sailing ship has ever been devised for the purpose he has in view. He is quite right in holding that his training vessel should have no steam appliances. Personally I incline to the barque rig, but that is a detail over which he and I need not quarrel. Next to personal training through an abund-

ance of teachers, the most important of all, is that incessant occupying of the mind and body which can only be had afloat on board a sailing craft, for a dreary round of instruction and drills that has no visible effect is a burden of discouragement.

Commander J. D. ADAMS, U. S. Navy.—When I took command of the training-ship Alert about eight months ago I was strongly impressed with the idea that a sailing training-ship and the consequent preliminary training incident to a sailor pure and simple, was the best adapted to produce a good man-of-war's man. Through force of circumstances the Alert was obliged to make a much different cruise from that which was originally intended, and the method of training had to be altered correspondingly. From the results obtained I am now inclined to change my former views decidedly and to pronounce in favor of the more modern system of training.

Lieutenant Beach gives a very clear definition of the purposes of the training service, and the only thing left seems to be to decide on the best method of obtaining the desired results. There is no doubt in my mind but that a thorough seaman, an active topman, and a "good all-round man" will fill the duties of the "man behind the gun" in the most satisfactory manner. A sailor is always full of resources and soon learns to handle the modern machinery which controls our new ordnance. But the question now arises, how can we make a sailor with only six to nine months' instruction on shore, and six months afloat in a training-ship? I think that is simply impossible, and that therefore we should devote the limited time allowed to training the apprentices for their future duties on board the regular battleships and cruisers.

To develop in the young apprentice a strong taste for his profession is of paramount importance. When a boy's or man's heart is in his work he will try to do it well. On board a sailing ship the apprentice is constantly hearing from the men composing the regular crew that sails are obsolete, or nearly so, and that he will never have anything to do with sails after he gets into the regular service. That is true and the boy reasons that he is being taught things which will be of little use in the future of his chosen profession, and consequently does not take the interest he should in his studies. He cannot see that his knowledge of ropes and sails and his smartness aloft will be of any use or great benefit in his future career. In this he is mistaken, but the fact remains, and in consequence thereof there is the lack of interest.

There is another thing which we must take into consideration in any system of training; apprentices must be kept contented and happy. The large number of desertions from training-ships is due mostly to the sudden and complete change in life which comes to the boy or man. At the best there is much discomfort in a sea life, and at first the enforced confinement on board ship, and the strict discipline necessary from the very start makes the apprentice feel as though he were almost in prison. He does not then realize that he will soon get so used to the discipline that it will become a second nature to him and that he will be allowed much more liberty and many more privileges after he enters the regular service. This is shown by the fact that the majority of the

desertions take place during the early part of each cruise. As a matter of fact there has not been a single desertion from among the apprentices on board the Alert since the time of my joining the ship. This is mainly due, in my opinion, to the nature of the cruise made by the Alert. She has not remained at sea, at any one time, more than ten days; and the result has been, plenty of good, wholesome fresh provisions, and a moderate amount of liberty on shore, fishing and shooting at Magdalena Bay, etc. This approaches more nearly to the conditions in the regular service. The apprentices soon learn that to have privileges granted them they must behave themselves and pay strict attention to their duties.

Sail drill is had frequently, and the time at sea is devoted to seamanship and to gunnery from a ship while underway. As the ship was never under sail at night, except perhaps when lying to under the spanker, the only disturbance of the boys during their regular night-watches was to stand their lookouts, and an occasional muster. The daytime was devoted to drilling for all hands; both watches being constantly on deck. This could not be done in a sailing ship. Growing boys require more sleep than a man, and this must be taken into consideration.

In port, outside of regular routine drills, boat drill was had every day, both under oars and sail. The steam launch was never off the rail, except for use in San Francisco and once for a few days in San Pedro. It was the usual custom to spend a week in port, and then a week at sea. While at sea, subcalibre practice was held frequently and the results were evident in the great improvement in target practice. As the Alert is quite a lively ship in a seaway, the constant practice in pointing the guns when rolling and pitching was of incalculable benefit. It was the custom to have the first sea practice in smooth water, but after that to have it under moderate sea conditions. The improvement in the times in firing the strings of shots was remarkable, and the accuracy of fire greatly increased. All sea practice and subcalibre practice was plotted. The regular quarterly rifle practice was held at San Diego on the Army ranges, and at Port Angelles in Puget Sound, and Magdalena Bay on improvised ranges. In making the necessary long cruises at sea in a sailing ship the gunnery part of the training must take a second or third place.

Referring to the list of subjects in practical seamanship given in Lieutenant Beach's essay, I may say that this is practically the course of instruction carried out on the Alert, with the exception that, as mentioned above, the instruction is carried out all during the day, as all hands are on duty in the daytime, not having had their rest broken to any great extent at night. The subjects of boat-pulling and sailing, lights, signals, heaving the lead and log, compass, etc., are of course given the most attention. An officer on one of the battleships complained to me the other day that the boys received from a sailing training-ship were not physically well developed. This cannot be the case when frequent pulling in boats is had, and this practice can only be held in port, and by the non-use of a steam launch.

I cannot agree with the writer that the whole preliminary training

should be had in sailing ships. Let us have steamers with some sail-power to give the apprentices activity aloft, but make the cruises between the ports of moderate length; and preferably make some good quiet port headquarters and divide the time equally between sea and port, never remaining in port over a week or ten days at a time. Pay strict attention to messing arrangements, and allow as many privileges as possible, and I think we will get the best work out of the apprentices and foster a love for the service which will insure the larger number of them returning to it when the period of apprenticeship has expired. At the same time I believe that the boys will be better fitted to take up their duties on board the regular ships.

While writing this I have just seen that England has decided to train her seamen in modern ships and has discarded the use of sails almost entirely.

Commander A. C. DILLINGHAM, U. S. Navy.—Before discussing the paper "The Training Ship," let me congratulate Lieutenant Beach on giving us a very excellent article on a very important subject.

The author says: "The person, thorough in his calling, aspires to no other." Development of character and acquirement of information are always coincident, but in developing the character of the young American, you do make him aspire to greater things. It is this very development that makes so few ex-apprentices remain in the service. The practical inducements to remain are not sufficient.

It is a matter of great regret that a larger percentage of ex-apprentices do not remain permanently in the service. But this is not the fault of the system of training, and the comparison of naval apprentices with a young man with an industrial trade is odious and illogical.

We are not a military people. We are an industrial people. A young man enters the service not as one does an industrial trade. The industrial trade harmonizes with the national character. As the navy becomes more of an institution, the military character of our people may develop, with this, and sufficient inducements for the future, we may find it as natural for a young man to have a military career as it is now for him to have an industrial trade. The young American is not content with subordinate positions, he thinks more of commanding a ship. The inducements offered for future in the industrial trades are greater than those offered the naval ex-apprentice, and above all the man with an industrial trade enjoys the independence so dear to our people. He is his own master and is as good politically as any other man.

An American is not naturally a subordinate creature. We are brought up to independence of thought and action. It is this independent character that is American, and the lack of independence is what detracts from the naval service for the average American lad. Until we become more military in character, we cannot expect our young men to follow a military profession permanently, unless the practical inducements offered in the navy are far greater than those to be had in an industrial trade.

No system of training will change the national character and make it military, and until such change does take place, I believe the Government

will have to be content with a small percentage of ex-apprentices remaining in the service. But ex-apprentices will drift back to the service in time of war, and as like as not, will have been members of the "National Naval Reserve," so that the money spent on their education is by no means thrown away. It returns to the good of the service in time of war.

There *is* a class of boys that *will* remain in the service, and it should be the endeavor to recruit such lads. I have reference to boys who have never known anything so good, so remunerative as the naval service, boys who have had no homes, boys adrift on the world who find in the navy more than they ever expected to find; there are thousands of such lads, not vicious boys, boys with bad habits, but boys born into the world with no homes, no one to bring them up, boys whose parents were poor and who died when the lad was very young. These boys enter the service and their condition is bettered. They appreciate it, and they find the navy a profession and the ship their home. If an American boy with good parents and a respectable home, with the advantages of a public school education, enters the service it is generally either a whim, or that something is wrong with the boy, he must need disciplining and his parents think the navy will do him good, but they have no idea that the lad shall remain in the service. The desirable boy is the one who finds in the service a better life and who with his pay finds himself self-supporting and comfortable.

I think that it is useless to expect any greater per cent of ex-apprentices to remain in the service than does at present. The problem is how best to deal with the training service as we find conditions to-day. Educate all that will come up to the limit allowed by law, and do all possible to make the profession so attractive from a military view point that the inducements to remain in the service will be the maximum. I do not think that the training service has failed in its purpose if a fair percentage of ex-apprentices do not remain in the service, but that some commanding officers have failed in not giving preference to ex-apprentices in the selection or recommendation for warrant and petty officers. They have not offered all the inducements to remain in the service and have not made it pay the apprentices to remain. Or may be the right class of boys have not been recruited.

The idea of an officer of naval training is a good one, provided it does not create another bureau, and by all means the Chief of Bureau of Navigation should be the Chief of Naval Training. The subject of manning the navy is so important that it demands the special or personal attention of a competent officer under the Chief of Bureau of Navigation.

I agree with Admiral Luce, Captain Chadwick and others who advise the sailing vessels for training.

I was brought up in the Luce school and my experience has verified the Admiral's ideas. The best man aboard a modern man-of-war to-day is the sailor man, and surely the best officers of the deck are those with sailing ship experiences.

I cannot agree with Lieutenant Beach as to the size of the training-ship. Small vessels are most uncomfortable and in handling men or apprentices the first thing is to make them as comfortable as possible,

with this accomplished you are going to get out of them all that there is in them. Besides so many such vessels are needed, that it would be impossible to get them. Better results could be obtained by doubling the tonnage of the vessels proposed by Lieutenant Beach (1000 tons), making the vessel barque rig and having twelve of them, with the same proportion for crews, allowing the apprentices to stand three watches at sea.

The school of the squadron is such an excellent one for all hands that I would have these training-ships cruise *always* in squadron. Without effort signalling would be perfected and competition would encourage the best efforts of all concerned, besides the unit is larger for educational purposes and you will better carry out a system in squadron with the S. O. P. responsible.

I am of the opinion that our apprentices are not long enough aboard the training-ship. I would keep them one year aboard training-ships before drafting them to the fleet. They will then be better developed mentally and physically, and will have had time to receive better instructions. With twelve vessels, two squadrons, of six vessels each, one leaving January 1st and the other July 1st.

The routine of drills and instructions should be prescribed, and it would seem possible with the experience we have had to do this, and it should originate from a competent and responsible head, such as the officer of naval training would be.

Lieutenant-Commander GEO. R. CLARK, U. S. Navy.—I think the writer has struck the key-note of the matter in his plea for thoroughness and the abandonment of the attempt to cover so much ground. The tendency is to expect too much, to look for a finished product, both as regards character and equipment. The handicap of heredity and lack of early training in many cases cannot be overcome in the six short months allowed on board the training-ship. Character development is all right and desirable, but muscle development and usefulness are essential. The one is of slower growth and follows the other. If we can turn the young man over to the cruiser well and thoroughly equipped in a few things, his welcome will be warmer, and the self-confidence that comes with the knowledge of his fitness and his ability to take his part in the ship's work with older men will make him hold his head up, and go far toward giving the right "slew" to his character.

Thoroughness, therefore, in a few things, in the important things, should be the aim. Some one has said that the question now asked of young men seeking positions is, not "what do you know?" but "what can you do?" That is the executive officer's question, we may be sure. It is of more importance that the youngster should be able to load, aim and fire the gun well than to know all about the principle of its construction. Aiming drill is better than lectures on "initial tension," and subcalibre practice than theories of exterior ballistics. The essentials should be insisted upon, and all else abandoned.

Infantry at sea should not take up a great part of the time, neither should it be wholly given up. It has been found that a good sharp

battalion drill, say once a week, in heavy marching order, is helpful in showing the importance of good organization, prompt obedience to orders, and celerity of movement. On the Essex several years ago this drill reached the point where, without previous notice of any kind, with the boys lying about the decks, the time required for formation in heavy marching order, complete in every respect, was thirty-five minutes. What contributed in part to this result was the plan of weeding out from the battalion all who, for any reason, had shown indifference, slowness or inefficiency of any kind, and detailing them to provide the equipments while the members of the battalion proper were putting on shoes, etc. In this way membership in the battalion came to be deemed a privilege, and non-membership a disgrace.

As a means to the thoroughness so desirable I am still of the opinion expressed in the Institute several years ago, that the proper routine is one that calls for "hammering" on one subject a long time before passing to another. It is the only way to make the knowledge stick. Of this, Admiral Bunce once said: "Training apprentices is best done by the repetition of facts until they are impressed on the memory, and the repetition of acts until facility in doing them is acquired."

Until a certain type of training-ship be adopted the individual instruction can be gained by increasing the number of petty officers, the real instructors, giving to a ship of the Dixie class not less than twenty for instruction work alone, all, of course, under the supervision of the watch officers. The time when commissioned officers had to count the pieces of underclothes of the apprentices is, or should be, past.

The importance of trying to make the boys like the service cannot be overestimated, and the means to this end should be well considered. "Tarrying too long with the sail when it is wet" will not help the good work. Frequent liberty on shore in foreign ports, as a reward of good conduct, is helpful. The remark of a marine on a Pacific cruiser several years ago, giving the reason for an unusual number of desertions, is not without significance. "They had enlisted," he said, "to see foreign countries, and as yet had seen nothing but the ash-whip."

The need, I think, is to concern ourselves not so much about the type of ship as about the system of drill, the general principle of instruction. At most, the function of the training-ship, of whatever type, is to give the boy his sea legs, to rub off his rawness, and to put him into such shape that when he is transferred to the cruiser he may be useful, and pointed fair for that period of his career where his real work begins.

Lieutenant-Commander JOHN HOOD, U. S. Navy.—In Mr. Beach's well-written and very excellent paper on the training of apprentices are several ideas well worthy of study, though our opinions differ materially on some points. His idea of a central direction control of the training service and the adoption of a system tending towards uniformity of training is excellent, and his idea that the short practice cruise of the apprentice before he enters the general service should be devoted almost entirely to seamanship and the acquirement of the knowledge, habits and character of sea life is much better still, and the more remarkable and forceful in that it comes from one of the younger officers of the service educated and trained as an engineer.

If we are to have an apprentice training system, and I use the word "apprentice" advisedly as separating apprentice and landsman training, which the essayist confounds and combines—I think the scheme outlined, on the whole, very excellent. There is considerable doubt in my mind, however, whether any adequate return accrues to the navy for the enormous outlay, both in money and effort, made on the training service. The percentages given of active personnel of the navy, both officers and men, engaged in this branch of the service, and thereby taken from the active service fleet at a time of great scarcity of officers and men is somewhat startling, and is, I believe, rather under than over-estimated.

Do we get any adequate return for this large stripping of the fleet of so many officers, and especially of so many of the most highly trained and efficient petty officers and men? Do enough of the apprentices and landsmen under the present system remain in the service to give the navy value received for the outlay? Could not the object to be attained—the manning of the fleet—be better accomplished otherwise, giving the use of *all* its trained men to the active fleet, and at the same time inducing a far greater percentage of recruits to take up the naval service as a life calling? These are questions suggested by any discussion on the training service, and are deserving of very weighty consideration.

While doubting the wisdom of the apprentice training system, I take it that it has taken too deep root in the service, and has too many ardent advocates among our best and most progressive officers, to be abolished or even greatly changed. So long as we have an apprentice system and enlist boys, training-ships and cruises are a necessity, as the character of youth and moral reasons compel a different system of training and the segregation of boys from men till they have reached a proper age and maturity. Moreover, they are in the time of life for school methods of training, and can be trained and taught in bulk and masses, so to speak.

In view of these facts, I agree very heartily in the main with Mr. Beach's ideas as far as they apply to the training of apprentices. But when it comes to the subject of the training of landsmen, which he combines in a common head with apprentices, I differ with him entirely.

This landsman training system is of recent origin in our service, and has not yet acquired rights of prescription; and it would therefore seem that if it is essentially weak and inefficient, now is the time to discuss it thoroughly and fully, before it becomes one of the "old institutions," which are always difficult to remove however poor and inefficient they may have proved in practice. That the system is essentially weak and inefficient for the purposes for which it was organized I hold for the following reasons:

1st. It unduly weakens the active fleet by depriving it of the services of a large percentage of the most efficient officers in the service, and more still by taking from it the large number of the best trained petty officers and enlisted personnel—always far short of our needs—and this at a time when the want of officers and petty officers in the active fleet is more acutely felt than at any time in the history of the navy.

2d. It is an irrefutable fact that men of mature years, even though

young, will not take and cannot be made to take the training of boys with any degree of success. Boys may be trained in bulk by precept as well as by example and experience. Men, especially of the class of our enlisted force, are trained by example and experience, and are indifferent to precept in masses.

3d. The placing of masses of raw recruits, devoid of all sea experience and ignorant alike of the hardships and the advantages of a naval life, on a vessel with a comparatively small leaven of seasoned men, leads to their demoralization. Their numbers are too great to be lead by the example and experience of the older men, and they become imbued with disgust and discouragement at the first unusual discomforts and hardships encountered. To the landsman sea life is as unnatural as cave dwelling, and far more uncomfortable until he becomes inured to it, and that he conceives a spirit of discontent and dissatisfaction, which is nursed and encouraged by being surrounded almost entirely by others of his kind, which causes him to desert frequently or leave the service at the end of his first enlistment, is only natural.

4th. The simple existence of the incomplete landsman training system of to-day leads to incorrect ideas of the proper training duties of the ships of the active fleet, the blame for an inefficient crew being thrown on the helpless training-ship, that from the very condition of things cannot train.

5th. The proper training-ship for *men* is the regular commissioned ship in active service.

That the training-ship for landsmen *cannot* train them to the state the time and effort devoted to them warrants, however zealous and efficient the officers of the ship may be, I fully believe. That it *does not* I think almost any officer who has had the misfortune of having almost an entire crew of these so-called trained landsmen dumped on him for his ship's complement will bear me out. That these same men could, under a different system, have been trained to a state of usefulness commensurate with the time and effort spent on them I fully believe; and that they could be trained to a better understanding of the service and a better spirit of contentment that would insure fewer desertions and a much larger proportion remaining in the service is unquestionable.

The simple way to accomplish this is to train men as men with men, and drop the system that works indifferently well with boys, but would not work—even indifferently—with them as they approach manhood.

Holding these views, I would naturally drop out the entire landsman training system from the plan Mr. Beach proposes, and for them start a system on entirely different lines.

I would first distribute all those we have now on training-ships to the various ships in active service and call back to the use of the active fleet all the officers and trained petty officers and men now engaged in that service.

In future, I would enlist these men, send them to barracks in convenient rendezvous for a period of from two to three months—not more—for a preliminary training in teaching them the meaning of the word discipline, how to hold a rifle and how to police themselves. As soon as these rudiments of military art were learned, I would draft them to

ships being commissioned for active service, forming never more than a third of the crew with these green hands except in some urgent case of absolute necessity. When possible, the proportion they bear to the older hands in the complement should be smaller, though in the present stress this would probably prove impracticable.

Placed there in the minority, surrounded by men who know the sea and its life, and are not appalled by its discomforts, personal pride will come to the rescue of the recruit after his first fit of seasickness is over, and he will learn more of the sea and its ways from the example of his shipmates in a month than can be instilled into him by lectures during a six months' training cruise. Every ship in commission becomes a training ship, and the officers of each ship who are responsible for the training of their men, with whom they should serve out a full commission, have the powerful aid of natural traits of human nature, instead of the feeling of working against a constant adverse and overpowering mental current in a body of men too large and ignorant to handle, with whom they are only temporarily and casually associated.

It seems clear to me that the way to get the best trained crews is to commission a ship for three years, make up her complement of as many trained men as are available, fill the rest with raw material, put the officers on board, both officers and crew knowing they are to serve the commission, then hold the officers responsible. Our officers are equal to the responsibility, put it on them. Do not waste a third of them and our best men in kneading dough that must be reworked to be baked.

Lieutenant-Commander W. L. RODGERS, U. S. Navy.—In the adoption soon after the Civil War of a system of preparatory training of recruits before sending them to general service, the Navy Department committed itself to a plan whose relation to the now existing conditions governing the supply of men for the navy was not foreseen.

The authorities of the day had before them the idea of producing in and by the training squadron a body of young seamen, thoroughly trained who should then be available for manning the general service ships. Their desires have been the controlling ones since, although present circumstances render them impossible of realization. The governing factor now is the average length of service of the American man-of-war's man, which is so very short compared to the length of time necessary to train him, that if he is thoroughly prepared in the training squadron, he has an unreasonably small part of his term of enlistment left for general service.

In this connection it is necessary to refer to the annual reports of the Bureau of Navigation, which show that 75 per cent or 80 per cent of the men in the navy serve only one enlistment or less. Here is the explanation of our lack of petty officers and leading men and our difficulty in training our crews. The remedy is simple; the government must offer in one way or other inducements sufficient to bring about a much larger percentage of re-enlistments.

For this reason of short service, all the discussion which runs on at intervals in the service and in the papers of the Naval Institute as to whether the work of the training-ships should be done with sails

or without them; whether the character of the young seaman should be moulded by teaching him to use a marlinspike or a monkey-wrench is very much beside the mark. The fact is, if the training-ship takes time enough to make men manually expert either as seamen or as seamen-gunners an inadmissible percentage of the men and money available is diverted from the combatant fleet.

The same argument applies to the attempt to develop character by work aloft. We must give it up and do the best we can in the battle-ships because the necessary time cannot be spared to do it in training-ships, whether they be sailing ships or mastless steamships. This position is similar to that called for by every other profession and trade, where the manual skill and mental resource and character called for by any line of work is developed by the practice of that work and in no other way.

When to the men under training, we add those serving as instructors and for other ships duties on training-ships the proportion of men withdrawn from general service is so large that it is apparent that special training can only be permitted within the most limited scope. If the training is as long as one year the number of men on the training squadron will equal the number of trained men in the general service.

We are, therefore, compelled to arrive at the conclusion that the greater part of the individual training and development of the American man-of-war's man must be carried out on board of the combatant ships, simultaneously with the divisional and ship exercises that develop the battle efficiency of the fleet. Any undue prolongation of the time spent in special training-ships will inevitably reduce the standard of efficiency of the ships in general service, besides reducing their number in proportion to the annual expenditure.

This consideration indicates very clearly the degree of instruction which should be carried out on board training-ships. It should be no more than enough to enable recruits on joining a service ship to take part in the work and drills without being a serious source of delay and embarrassment to the rest of the ship's company. The standard to be attained by recruits before transfer to general service should be approximately as follows:

Their clothing and hammocks should be in good condition and complete in every way and they should know how to take care of them and to keep themselves clean as well. They should be able to pull an oar and take care of themselves in a boat, and should know the infantry squad drill and manual of arms. In gunnery they should know the six-pounder drill and where ammunition comes from, and how it is supplied and should have had a few sighting drills and a round or two of small-arm target practice. They should understand the object of the different organization bills of the ship; general and fire quarters, abandon ship, etc., and what is to be accomplished at each exercise. They should be accustomed to move freely, orderly and quietly about the ship and to work in organized bodies and should have had enough gymnastics to give them good carriage and control of their movements. Finally they should have had some exercise in signals, heaving the lead, knotting and splicing, and the use of the compass.

This can all be done in three months, and can be done in different ways. If a ship is sparred, it may be combined with some work aloft. If the ship is mastless, there may be boat work under sail. Almost any good routine of ship's work will develop effectively both mind and body if it is carried out with diligence. It does not appear to me that drill aloft is an essential part of the preliminary training of a naval recruit. Foot-ball would probably do as much to develop character, courage, and the habit of organized effort, if only it were as convenient. As it is, we can do all that is necessary with any type of ship that does not call for great attention for her own care. The three months' training should be carried out by one months' training in barracks and two months on shipboard, and the barracks and ships should keep in very close touch with each other; so that the time devoted to each should be uniform for every one. Otherwise some people will not get all the instruction proper, and others will have their time wasted.

It is unnecessary to prescribe an invariable routine for all barracks and training-ships. It is quite enough to require that at the end of the time in barracks a certain standard shall be reached, and after leaving the training-ships the recruits shall be inspected and examined on the general service ships to which they are sent to see that they are qualified as required by the Navy Department. At the end of the month in barracks the recruit should understand the care of his bag and hammock, know the infantry squad drill and have had a little instruction in shooting, boating, marlinspike seamanship and gymnastics. In the two months on shipboard the instruction in seamanship and boating should be continued and in addition to the secondary battery work and divisional drills should be begun; together with signals and use of the lead.

All this work is much better taught in port than at sea. Very short trips at sea are enough to teach the sea routine, but circumstances are not at all favorable to instruction under way, as the ship then needs attention, to the prejudice of the recruits; and the latter are dull under instruction if they have been working the night before. Steering should be taught mainly by boat work.

We must be content to have recruits join the general service ships long before they are fit to be called man-of-war's men. Their education must continue. The program of drills must provide one set of exercises for organized divisions to develop the ship's battle efficiency and another set for the individual training of the crew in their personal duties as seamen and gunners. To do this satisfactorily calls for a complete change in the character of work assigned to petty officers. At the present time instruction is entirely in the hands of commissioned officers. Petty officers do little to aid them; it is required of the latter only to act as leading men in all ship's work. It is an impossible task for one officer to give detailed instruction to a large division. There is only one way it can be done, and that is by making each petty officer responsible for the instruction of a squad of men while the divisional officer supervises all. At the same time, the petty officers must be aided by the Department, which should prepare, publish and issue manuals for petty officers giving drill instructions and other information suitable for

their use. In this way, and by this way only, it seems to me, can the members of the crew receive the individual attention and instruction necessary to turn recruits into man-of-war's men. A greatly needed reform will have been effected in the navy when petty officers become good drill masters.

A word in regard to the comparison of landsmen for training and apprentices. The apprentice system originally commended itself to the navy as an effort to get native Americans into the navy at a time when foreigners were in the majority and small results were thought satisfactory. At the present time the landsmen are drawn from the same sources as the apprentices, by the same recruiting parties and are trained by the same methods. The differences between the two classes of men are entirely owing to their ages; apprentices being shipped between the ages of 14 and 17 years and landsmen between 18 and 25 years. From every point of view the results indicate the propriety of shipping recruits over rather than under the age of 18 years; and therefore the apprentice system should be abandoned and that of training landsmen should be developed. Owing to their youth, the apprentices are less attentive and zealous under instruction, and even after they have been transferred to general service they remain immature in body and mind for a large part of their term of service. Statistics show that a very small part of those enlisted as apprentices serve out their terms, and a large number of these fail to re-enlist; so that the apprentice system accomplishes little in manning the navy in return for its cost.

As for the quality of the petty officers it supplies to the service, it gives many good ones, but I think individual comparisons will satisfy any inquirer that just as good ones came by general service enlistments. On the other hand, landsmen shipped at or above 18 years old are valuable men almost from the first, and the government gets a better return for its investment.

Lieutenant F. P. Baldwin, U. S. Navy.—Just to start my remarks, I'll state that I am one of those who believe that the present training service can be improved upon, and I believe that the improvement is quite within the reach of the navy without outside aid.

My experience in the training service has all been with boys, so I may be pardoned if I confine my remarks entirely to that branch.

I am with Lieutenant Beach in thinking that there should be more uniformity as regards the training, though I think that this should be more in the form of a system than a routine; a system that fixed the things that an apprentice should know before transfer to the general service, taking into consideration his abilities and previous education. But I am not at all in sympathy with a hard and fast routine that makes little or no allowance for the varying length of stay at sea or in port. I have seen shipmates with such a routine, and it happened that nearly always when the routine called for boat drill it was raining, we were coaling, or some dignitary was to visit the ship and the drill was postponed. So we brought back to the States as poor a lot of boatmen as I have ever seen.

I would emphasize his remarks about the inability of a boy to stand

watch and watch, day and night, and then pay attention to instruction or lectures. It seems to me rather that it puts his ingenuity to the test in finding ways to shirk.

I agree with him in his selection of a brig of about 500 tons and in his condemnation of a converted freighter for training. But I would have these solely for seamanship, and there should be no great guns aboard. With him and with many others I believe that there are qualities of coolness and self-reliance that are gained aloft better than in any other way; but I think it folly to subordinate other much more necessary training to this square-yard work.

The yards and sail of a bigger craft than these brigs are too big for boys to handle. Does a boy know how to furl a sail until he stows a bunt—and on our training-ships who stows the bunt of the topsails and hauls out the weather earring in a gale? the apprentice? Oh, no! the captain of top, a man who has been to sea most of his life. The ship is too far from land to risk losing a topsail.

From the Department's action in commenting upon and in altering various itineraries, it appears to be the prevailing idea that the efficiency of a training cruise depends on the length of time spent at sea. But is this so?

Boats under oars or sail can only be taught in port. And from the nature of service, unless the apprentice learns before transfer, he is liable to go on without knowing.

Gunnery instruction can be better given at anchor than when rolling about at sea. Great gun target practice can be held a few miles from our own coast as well as in the middle of the Atlantic.

Ground tackle and carrying out anchors only in port.

Signals of all kinds can be taught on shore, or on a ship at anchor.

Heaving the lead can be properly taught only when under way on soundings, as there is more art in finding bottom than in throwing the lead round the head.

Heaving the log may be taught when the ship is under way, whether on soundings or not.

The school of the soldier can best be instilled on shore.

Nomenclature of ships, spars, rigging and sails can be taught at anchor.

Marlinspike seamanship as well at anchor or even on shore as at sea.

There remains then the training at the weather earring or the topgallant fid. To make this effective the work must be done at times when reefing topsails or housing topgallant masts is necessary on account of weather, and for this we must go to sea.

So I submit, with all deference, that sending a training-ship on a foreign cruise, taking thirty days to go and as many to get back is a waste of valuable time out of six months' training, even if she does chance on a gale when you can do a sailor's work in a sailor-like way.

The lad at the weather wheel is the one that learns to steer—and how much more he learns when steering full and bye with an eye on the royals than when holding a course. On a long cruise you are holding a course most of the time unless the winds are very contrary.

My Utopian ideas crystallize as follows:

Extend the course at the training station to a year, since it is over a year now before the apprentice is ready for general service.

Have attached to each training station two or three of the brigs and one of our converted yachts, each to have its complement of officers and a skeleton crew of petty officers. The yacht to be armed with one 4-inch R. F. G. and one each of as many as possible of the various kinds of secondary battery guns. The crews of these should be selected men. Misconduct, were it only smuggling tobacco to the apprentices, should mean instant transfer to cruising ships.

The brigs should take cruises of a week or more, usually anchoring at night and giving the apprentices all night in, except for an anchor watch.

Gunnery instruction and great gun target practice on the yacht, with a small arm range near Gardiner's Bay.

On both brigs and yacht instruction should be given in heaving log and lead, and at the wheel.

The duties on board these ships should be progressive on successive cruises, so that each boy would go from deck duties to the royals and from shellman to gun captain.

We would thus break him in gradually to the sea habit, instead of taking him from the station where he has had hot fresh water to bathe and wash his clothes in and fresh food to salt water and thirty days of sea rations. Habits of cleanliness cannot be impressed when a half-bucket of fresh water is served out to every two boys.

My contrast of the two methods is in a measure illustrated by my own two cruises as a cadet, both in sailing ships. On the first we went to Gardiner's Bay. There we anchored at night, were up at daylight, under way before breakfast, and worked till dark either manœuvring under sail or working with the anchors. We kedged, we carried out anchors in boats, and we pulled and sailed boats, things which I have never seen decently done in a training-ship. Saturdays and Sundays we spent in New London or Newport and had liberty. On the second cruise we would leave the Capes, sail a hundred miles or so to sea, turn and sight the Capes before standing to sea again. There is no question in my mind that the cadets learned more practical seamanship on the first than on the second.

The part of his training that an apprentice gets at Newport is at fault only in the fact that when he comes aboard ship he is more a soldier than a sailor. But his habits and his moral character are liable to be far better than after he has knocked around such ports as Christiania and Barbadoes, both ports of call on training cruises. Of course his fall from grace might come in time any way, but at that age in a boy's life a year is a long time and goes far towards making him a man.

Lieutenant S. E. W. KITTELLE, U. S. Navy.—The immediate need for men in the navy is so great that systematic steps must be taken at once to get them afloat in the general service sooner than the present conditions permit. A year in the training service is prodigal, it reduces too greatly the time for which the recruit is available as a working factor in a cruising ship, and when one considers how few enter upon a

second enlistment the loss is accentuated. All theoretical conditions aside, we must face the practical fact that the big gap in the enlisted personnel remains unfilled. It has been found that the apprentice system, although excellent in its way, does not man the ships, so a system of training landsmen has been entered upon, and therein lies our salvation.

The naval recruiting parties travelling about the country have been quite successful in securing landsmen, and I believe that if the number of such parties be increased so as to more completely cover the country, as do the salesmen for the great wholesale firms, that the service complement might be kept filled.

Training stations should be established at points where the temperature is moderate, admitting of out-door work. As for example, on the Atlantic coast the New London station would be available from May to October and the Port Royal station from October to May. One should be chosen on the Pacific, and possibly one on the Great Lakes during the summer months. To these stations the recruits immediately upon enlistment should be sent for one month, not longer, the time to be devoted to instruction in cleanliness, the care of clothing, discipline, coordination and the elements of marksmanship. After this the recruits are ready for transfer to a training-ship, the training-ships making their headquarters at the training stations.

Considering the urgent need for men afloat, three months on board the training-ship will be enough to fit recruits to take their places in the complement of a sea-going vessel. In this time they learn to live and take care of themselves on board ship, to pull a good oar, to lower and hoist boats and pass stoppers, to handle the gear of boats under sail, to go aloft fearlessly and to know something of the gear thereof, to box the compass, to heave the lead fairly well, to make simple knots and splices, to perform the duties of the various numbers in main and secondary battery gun's crews, to handle the rifle and revolver, and have the experience of one quarterly small-arm target practice. They will have a fair knowledge of the manual of arms, the facings and marchings, be able to grasp a single stick by the handle, know the setting-up exercises, the duties at general quarters, fire quarters, arm and away boats, abandon ship and first aid to wounded, and will have learned to render ready and cheerful obedience to orders. This has been and can be done if the training-ship does not go to sea for more than several days each month, just enough to give the men an idea of sea routine and watches. A longer period at sea invariably interferes with rapid initial training, for at sea the ship demands the attention instead of the recruits, rough weather or storms prevent drills, night watches weary the men, causing interest to flag, seasickness destroys comprehension for many, opportunities for scrubbing are less frequent and the men do not attain such cleanliness, a serious defect at a time when their habits are forming. The "habit of the sea" is an excellent thing, but we cannot expect to develop it in a superlative degree in so short a time in a training-ship, it will come in general service later in the enlistment.

It is a mistake to expect the divisional officer to give individual instruction to landsmen in all the details of training, he should actively supervise the whole division. We have been struggling for years to develop petty

officers to perform their proper drill functions according to the army standard for sergeants and corporals, and just as success is within our grasp and a school for petty officers in full blast, it is not expedient to return to obsolete methods.

Lieutenant-Commander Fullam has obtained excellent results with the squad system with petty officers and seamen as instructors, the divisional and warrant officers moulding the whole with an eye for results.

To insure contentment, landsmen fresh from civil life and unused to close confinement should be given shore liberty at least once a month. This is done at Port Royal by taking the men to Savannah or Charleston once a month.

Lieutenant M. H. SIGNOR, U. S. Navy.—Mr. Beach has taken up what seems to me the most important subject, and he presents it very clearly.

We do need a more careful organization of the training service. I think everybody realizes that. To my mind, the whole subject of training is so important that it should be united under one head, which should be responsible for recruiting, training and promotion, and should not be distracted or diverted by other duties, but should have more authority than the Bureau of Navigation now has over the various courses of training—at the Naval Academy, the War College, the training stations, and on board the ships, both of special service and general. The board, or bureau, or office, whatever it may be, should also be the judge of the qualifications—standards—necessary for the advancement of officers and enlisted men.

Naval training is an art, and its end is war. Peace training is as the preliminary work—studies and sketches—of the great painter: of small value in itself, usually, except as leading up to the execution of the masterpiece. For the painting of a great picture we would select a master of the art. To direct the training of the navy a master of no mean order is required, and he must have able assistants. As in civil life it is recognized that men who have achieved marked success in particular undertakings might be unsuccessful in others, so in the navy some officers might better be employed in general service than in training, and those who *are* detailed to training-ships, particularly the commanding officers, should be especially qualified. The mechanical operation of following a routine, however good, is not sufficient.

As the square-rigged war vessel has passed away from general service, and the masted ship remains but a relic of ancient days, so the masters of square-rigged seamanship are passing away or attaining such rank that they will never again direct the reefing of the topsails. The lives of the officers now in the training service have been spent chiefly in modern steel ships, where what little they ever learned of handling ships under sail has given place to more practical problems.

Experience in sailing ships is rapidly becoming less. Much time is still given to it at the Naval Academy, but only half as much as formerly, and that half might well be devoted to other things. The amount at present is insufficient, and it will naturally grow less year by year. We are not properly qualified to teach seamanship, and will grow worse every year.

We have been using for training-ships whatever might be available. The square-riggers will gradually pass away unless we build new ones; and it appears to me that when those officers who were brought up in the palmy days of well-trained sailing ships have passed away we will no more have sailing ships-of-war than galleys. The technical knowledge necessary for handling sailing vessels cannot be acquired without years, not months, of work, and that technical knowledge is of practically no value to the modern man-of-war's man. The time available in an apprentice cruise, even if it be devoted to old-fashioned seamanship, to the exclusion of all else, is insufficient to make good seamen. So long as square sails are carried the first mark of credit or discredit will go to the proficiency of the ship in seamanship, and the principal struggle will be to make seamen, topmen, of the apprentices. Gunnery will receive purely secondary consideration, or be neglected, as being inconvenient in a sailing ship.

If the spars and sails could be carried as an auxiliary, a minor means of training, a diversion, or for physical exercise, they would do little harm and much good. But they cannot. They demand too much. They demand everything. They demand that the vital branches of training, the training necessary for fighting the various machines which have replaced the old ships, be neglected or regarded as secondary matter, instead of being, as they should be, the subject of all the interest, all the improvement, possible.

What results in seamanship are now achieved? Are the apprentices good topmen? Have they the qualities of the self-reliant "handy" man of whom we were once so proud? Do they jump aloft at night with enthusiasm to reef or furl a topsail? Are they quick to man the gear, the right gear, in an emergency? Do they show any sense about such things, indicating interest in them?

My own opinion, which I hope is incorrect, is, that they do not remain long enough to learn thoroughly any part of seamanship in the training-ship, and therefore have no enthusiasm for it; that they are not self-reliant, and in an emergency have to be driven like sheep; that they are indifferent fair-weather sailors and worthless in bad weather; that they are not strong enough for good topmen in bad weather, and by the time they have learned to use the strength that they do have they are back from the training cruise, ready to bid a joyful farewell to the wet topsail and its swollen gear. What they have learned about it, they very naturally and properly forget. If you wish to find out just how much a boy *can* forget, take the average apprentice after he has spent two years on a modern ship and examine him in training-ship seamanship. He will have no thorough knowledge on any essential part except such knowledge as he has had occasion to use on the modern vessel. Of course there are exceptions; but nature is wiser than human trainers, and she takes away unused knowledge from boys' minds to make way for something else.

The heroic quality, the "handy" characteristic, the self-reliant spirit, can be most quickly developed in hard service, where every man or boy has a considerable portion of useful work and responsibility and cannot shift it to somebody else; and he would get more valuable experience

in a merchant bark short of hands in a voyage between New York and San Francisco than in his six months' cruise in one of the present training-ships.

Perhaps the most important opportunity for training is in boat expeditions, not necessarily for ferrying people and stores, but for a thousand and one purposes for which orders may be invented—to round a buoy or an island, to explore a beach for landing places and sand for decks, for swimming and the like, to explore the creeks in the vicinity, to give the men and boys a run ashore where the locality is suitable, to spend the day at target practice on the beach, to hunt or fish, and, last but not least, frequent informal boat races. With a little encouragement any crew will take to boats with avidity. Small expeditions teach them confidence in themselves; larger ones, with officers in charge, give them confidence in their officers and give young officers their most valuable experiences in peace time. I would like to see at least half a dozen small boats—stout dinghies and light wherries—in every training-ship (and in the larger ones, for that matter), and they should have false keels, easily attached, for sailing. I look upon boat training as of more value to boys and other recruits than handling sails and manning gear, and it is as valuable at sea as in port. We have seen training-ships tack and wear and shift topsails day after day, under orders, perhaps, not to make port until a certain day. I have not heard, however, of stopping at sea for a sailing race; yet the latter seems to me more valuable in the development of the modern seaman, and only less important than the actual training with guns and engines providing for the day of battle.

Lieutenant Cooper many years ago pointed out that the remarkable state of efficiency of the navy in the war of 1812 was due to the practice, in the years just preceding, of laying up the big ships and sending the officers and men to sea in the smaller ones, so that more officers and men received experience in responsible positions. I believe that a small gunboat or torpedo-boat, having from twenty to forty men in the crew, will, if on hard service, be able to improve her crew as much in six months as a battleship or sailing ship can hers in three years. The smart apprentice, either in the deck force or the engineer's, who has had six months' service in a torpedo-boat in hard service (not lying in port and making occasional runs), should be ready for responsible duty. At the end of a year, if he has the right stuff in him and has been carefully trained, he should be an efficient, reliable, petty officer. What he knows, he knows so thoroughly, so confidently, that he will not soon forget it.

We cannot put 2500 apprentices on torpedo-boats; they would be out of place there until they had received some naval training; but the torpedo-boat and the small gunboat offer so valuable a part of naval training that they must not be forgotten. We have some boats that might well be used up in training young men for torpedo-boat service. It is a common experience that men who have had torpedo-boat training are in great demand for other service; and the more unsatisfactory a torpedo-boat is *per se*, the more valuable the experience to her crew. We are spending more money in building sheds for torpedo-boats than it would cost to keep them all in commission.

The small gunboat seems to me the next best type for training. The sea habit and the seaman's handiness are best developed in small vessels, to which the struggle with the elements is a serious one, and on which work is done with very definite object, more apparent and more forcible than the requirements of drill or routine; but the crews of these also should have had previous training.

The Buffalo is too much of a hotel or winter excursion steamer. There is little in her life to develop resourcefulness. Small vessels, to which much of the weather is bad, are better. It is bad weather that makes good seamen; bad weather teaches a man that it is "up to him to do something" though he be seasick, or hungry, or tired.

The ideal plan seems to me to have two squadrons sail from the Atlantic coast each year, and one from the Pacific, returning the following year after having circled the globe. They should be composed of gunboats, say eight in each squadron, and should accommodate about 3000 apprentices and recruits of all classes. Each cadet graduate from the Naval Academy should spend a year in one of these squadrons before being sent to a vessel in general service or detailed for construction duty or special study.

The general plan of instruction should be uniform, but the routine should be flexible, and the details should be left to the commanding officers. The *esprit* developed by healthy rivalry is worth considering, and much is to be learned by squadron sailing. Incidentally, we might develop a practical system of naval tactics. The more squadron sailing we have, the more we shall learn of the squadron tactics upon which, rather than upon the tactics of single ships, our success or failure will ultimately depend.

When we build naval vessels we should if possible make them suitable for war purposes. Gunboats of about 1000 tons should be useful to a squadron commander. They should be able to maintain ten knots' speed in ordinary weather, and should be effective against torpedo-boats at short range and against merchant vessels at long range, and should be suitable for transport, convoy and blockade. They should have large coal capacity and the battery should be especially designed for training apprentices and other recruits for service at the guns of the larger ships.

The type I have in mind would be about 162 feet long, 36 feet beam, 12 feet normal draft, and 1000 tons displacement, carrying 120 tons of coal at normal, and have a bunker capacity of 250 tons. The contract should call for a trial of 48 hours duration, the speed not to fall below twelve knots *for any hour*, and the fireroom force to be of the same number as in commission. The coal burned should not exceed a definite amount, say 43 tons for the 48 hours, and the water used for make-up feed should be replaced during the trial by evaporation. It may be that these requirements are not important, but they seem to me more suitable for a gunboat than a much higher speed maintained for a few hours. The battery might well be two 5-inch, four 3-inch and eight 1-pounders, all of the highest power in service, and all carried on the main deck. The "gun" deck should be free from guns, and the principal length amidships should be crew space, with large square ports

for fine weather and large air ports. The dynamos and evaporators should be in the engine-room, which should have ample means of discharging its hot air clear of the ship, and all motors outside of the machinery space should be electric.

Provision should be made for 14 ward-room officers, 10 chief petty officers, and at least 200 men and boys. The apprentices of the seaman class would be in five divisions, ordinarily.

The vessels would be able to steam 3000 miles at 12 knots in good weather, or over 5000 miles at slower speed. They could cruise for three weeks without recoaling, or blockade for five weeks, and they should be comfortable in good weather, in hot or cold climate.

After a year in such a squadron the apprentice should have acquired "horse sense" about guns and boats and steering. If strong enough he should be smart at the 5-inch, 3-inch or 1.5-inch guns, and a good oarsman; and he should know something about boat sailing and tideways. With a little training he should be an efficient member of a large gun's crew.

We should then have nearly 3000 men and boys who would know some of the fundamental principles of naval life thoroughly, ready to take their places as efficient units on ships in general service. It is idle to put 100 recruits in a division, with but one officer and one or two petty officers to train them. At the end they will not be worth the pay they have drawn. If we are never more to have war, it makes little difference. But if preparation for war is the object of the expenditure for naval ships and naval training, *we must have good officers and men, and we want them as soon as possible.*

I offer apologies to Captain Sigsbee, Commander Rittenhouse, and others, for trying to say some things they have already expressed more clearly.

To those who are grieved to note the gradual disappearance of the square topsail, I will say that I also regret to see it go. Though I have learned no more than A, B and C of the sailing alphabet, I have found particular pleasure in it. There is nothing that will fill its place. But it is doomed to go—the square topsail has practically disappeared from the navy already, and will give place in the merchant service to something simpler. The sooner we realize that we have been marking time when we had no time to spare, the sooner will we recognize the fact that we are imperatively called upon to devote our whole energy to the practical problems before us and to become as thorough in them as we once were in handling sailing ships and smooth-bore guns. Then, the more nearly complete would be our preparedness for the eventualities, the crises, for which the country is now supporting us.

DISCUSSION.

Captain Chadwick's Letter Relating to the Training of Seamen.

See No. 98.

Ensign T. C. Hart, U. S. Navy.—Having read in the Naval Institute publications Captain Chadwick's letter on training recruits for the seaman branch and the subsequent discussion thereon, I have received the impression that many of the officers who believe in and so strongly advocate the sail-and-spar training system have misunderstood the motives and arguments of the officers who have spoken against it. In fact, very few officers have *written* against it, but a great many have in the course of the day's work very emphatically *spoken* their minds. It is natural that, in many such oral discussions on the subject, a spirit of criticism not only of existing methods, but even of existing authority has sometimes been manifest—it is natural because they are Americans; it is also natural that those senior officers who now constitute that authority, and whose past efforts and systems have raised our navy to the high plane it to-day occupies, should hear of such discussions with impatience, and hold some resentment against those who at times use intemperate language in them. By personal inquiry, I have found that a large number of the officers who have had recent experience in the training service, and of others who have given thought to the subject and whose view of the field has *not* all been from a cadet practice-ship, have about the same ideas on the subject. If they would *write* their views, they would be expressing them in colder blood, and would not be intemperate in language; and, in my opinion, the desired effect would sooner be obtained—for the present system of training is bound to be changed some day, and the effort should be made to hasten the event. It must, however, be borne in mind that the present system is actually in existence, is in working condition and is turning out recruits and that a healthy conservatism must be overcome by logical arguments; in other words the burden of proof rests with the advocates of a new system. And when they have proved that the present system is *not* the best practical one, they must have a new system, well outlined and defined, ready to propose in substitution, and the arguments prepared to prove that its substitution will afford advantages great enough to make it worth the trouble.

Considering the knowledge of work with sails and spars gained on our sailing training-ships, it seems to be the prevalent opinion throughout the service that a competent man in any station, no matter what specialized ability that station calls for, is the better for being a good square yard seaman, able to do the most difficult work aloft, provided he acquires that ability without loss of deftness in his specialty. That such is the case is in fact a most general principle, for any added accomplishment improves a man; a stenographer is a more valuable man for being something of a doctor. I do not intend such an extreme case as a parallel; for there is no doubt, that any man who earns

his living at sea is, no matter what his specialty may be, greatly improved by a course in sail and spar training, if in taking it he loses nothing in his specialty, which would not likely be the case. The question is whether or not it is worth the sacrifice we must make to it. A marine or a machinist so trained would be a better man for it, particularly in those emergencies at sea for which we must take some risks, in the impossibility of guarding against them all; but no one would believe it advisable to so train such men; their added efficiency would not be worth while. Since a battleship sailor should be something of a machinist and marine, the above comparison is not extravagant. Among his duties on a modern ship the nearest approach to seamanship, in the old meaning, is the work a seaman does in handling coaling and cargo whips, mooring and towing lines, etc.; to this of course must be added sailmaking and "marlinspike" work, and the all-important work in small boats, which certainly can be learned outside a deep-sea sailing ship. This small part of a good man's ability is the result of all the useful information that is culled out of the mass of seamanship that we try to impart in a six months' cruise; in which we aim to make all other instruction a secondary matter. And most of that seamanship education is soon forgotten simply because it is not useful; the part that *is* useful is a small part of what a good modern ship seaman must know. However, be it admitted that a square-yard seaman, the genuine article which it takes years to produce, is for some reason a handy valuable man on a modern ship, and let us consider the efficacy of the present training system in developing and forming character, which, it is claimed, gives it its principal value.

The best idea of what the old seamanship does in forming a man may be gained by considering, as an example, the case of a seaman brought up in a merchant sailing ship, for there we will not have to hunt for that part of the man's character through the polish produced by the self-respect which is the natural consequence of military discipline, better associations, care of the body, etc.; and will see sail and spar formed character laid bare. A merchant sailing ship man on board a modern man-of-war is usually handy for sailmaking and marlinspike work, because there are few of them on board and there is enough of that work to keep them busy. They can do it well—they do it in the ox-like way a Russian serf works—but they can't handle a winch, work about a gun or shoot as well as many green landsmen; with an apprentice's shore training the landsman wouldn't bungle half as many things on board ship and would be of much more use with a landing party. A merchant seaman is so hard to teach anything new, that were it not that they come in handy for such work as sailmaking, they would not be of much value to a modern ship, and it is common knowledge that, when left to their own resources on shore, they are most helpless fellows; their characters do not appear well then. But that sort of a man can furl a topgallant-sail alone in a strong breeze and should, if such work is good for it, thereby develop more initiative and independence of thought than do our recruits, for several of them would be sent aloft to do the same work and would do it under the minute direction of two or three

petty officers and at least one commissioned officer, who would forestall the slightest mistake. I have sometimes wondered if a layman, who could see a small sail handled under those time-honored conditions and then be taken to a dynamo-room where a third-class petty officer, with no one watching him, was in the act of cutting in a fresh dynamo, an operation in which a slight mistake might play havoc, might not think it strange that a navy, which insists on such a state of affairs, so well sustains its reputation for being up to date. Many of our recruits see that side of the matter, decide that they havn't much use for sails and wonder why they are thus kept wasting their time; such ideas are not good for morale and discipline.

A sailor's work aloft is undoubtedly often dangerous, and, like anything else that brings a man into danger and makes his safety depend on his own exertions, nerve and foresight, helps to make a real man of him. But there are other ways of doing it than having him cruise on a sailing ship for several months. A small boat may be sailed in weather that will make safety of life and limb as doubtful as is thought necessary. Probably they would not be sent out in bad weather, but our cruising training-ships also "play safe"; they avoid bad weather when possible, and when any work aloft has to be done under conditions that will make it more than usually hazardous, the recruits are not often sent above the rail. Work with sails certainly develops the body and our apprentices grow wonderfully on a cruise; any boys of their age grow, and ordinary gymnastics will more systematically develop the muscles. It is well known that infantry drill is an excellent way of first subjecting men to discipline, much attention is paid to it at our training stations, where fixed rules and routine are followed, all parts of the daily routine being carried out in a strict soldierly way. The recruit so trained is sent to a small training-ship, where stress of weather, the numerous unforeseen things that are always happening to such a ship, shifting from sea to port routine and vice versa, make fixed routine and rules entirely impossible. All the new mode of life, the strange surroundings, the mass of seamanship that we teach him with so much haste and energy, and the continually changing rules and routine fairly bewilder him; he finds that the strict military drill and discipline he has learned cannot be properly carried out; his sail drills, in which he does not see much use, are made prominent and often go with too much of the old helter-skelter, get-there way for him to follow them; in consequence he often becomes discouraged, grows lax in discipline, and comes to regard his six months' cruise as something to be gone through with as easily as possible when, unless he deserts, he will begin to learn some useful things. To my mind there is one thing particularly harmful to morale and discipline, that closely clings to our old sailing ships, for which the old days of liberty once in three months causing a general orgy, many resulting court-martial cases and always a bad disruption of ship organization for at least a fortnight, are responsible. The same surroundings that accompanied and perhaps helped produce those conditions still exist on what old ships we have left, but such a catastrophe rarely happens where good conduct men know they will be given frequent liberty as is done in barracks and on our modern ships. Our recruits

make a voyage of several weeks on a sailing ship, where they are safely removed from all vice and then enter a strange port, where everything, including ways of amusement, is different from what they know, and where vice is plentiful and exceedingly easy to get at; it is human nature that a man is under such conditions inclined to all kinds of intemperance, and many young fellows who would have been better behaved otherwise, thus get started on the road to drunkenness. Depriving a man of his usual everyday comforts on a training-ship's voyage may act somewhat as does depriving a soldier of beer at the canteen. Besides that feature, the very traditions that cling to those old ships, including visions of tar-stained men who use a language of nautical expressions, habitually take their lives in their hands at sea and always of necessity get howling drunk ashore, have their effect. Apprentices think that such conduct is a necessary qualification for becoming "sea-going," and a seaman who can be trusted ashore when in reach of rum becomes incompatible with their ideals. Considering the above, in my estimation, the *instruction* gained on our cruising training-ships, including instruction in useful things which *is* given sparingly, is really of more value to the navy than any improvement in character that results; and after all we are working for the navy and not to reform refractory boys or to take idle ones out to see the world until they become tired of it and leave. Attempting to do our share of broadening the minds of our countrymen by taking some of them abroad while young should be as remote from our aims as should be making preparations for taking in such sailing prizes as we might capture in war time.

The recruits we wish to get for our service are native born and are of about the same class as the men who enter the army. Few Americans in the face of these prosperous times and consequent good opportunities in private life enter either service with the intention of remaining in it more than one enlistment. Many *do* reënlist of course; they are either of the kind having a peculiar temperament well suited for the service who reënlist time and again, and, though few in number, are of immense value to the service, or of the other more numerous sort who realize that they can make an easy living by staying in, and are not very energetic. It is safe to say that the majority intends to go through one enlistment for the novelty of it and the benefit and local renown that results from military drill and discipline, seeing the world, etc., and then to stay out. We are working for the good of the navy, and it should be our aim to get as much *useful* service out of recruits as is consistent with sufficient preliminary training, keeping in view the necessity of making their period of service sufficiently attractive to induce numerous reënlistments: be it said, however, that making it attractive cannot be done by merely paying them well; it is necessary to use consideration in other matters which is not inconsistent with giving them plenty of hard work. If we wish to get as good recruits as the other services obtain, we must appear to offer as many advantages as they do. A condition to be accepted is that our term of enlistment is short, compared with that of the British Navy, that we have no conscription (it's easier to be an officer in a conscription service), and that we cannot tell how long we will be able to keep men in; for that reason it may not be

profitable to spend as much time in preliminary training as do other navies, even if our recruits are considered so dense as to need it.

The building and maintenance of a navy is largely a matter of dollars and cents, and we must get as much out of the money that is allotted us as possible—we are not likely to get too large a sum. We have at present in the cruising training service twelve ships of various types, not counting others now projected, manned by 116 line officers, and, allowing a scant complement of 125 old service men to each ship, 1500 men. In addition to their work in training, they do a small amount of service as transports, and of necessity are at times utilized for ordinary duty in protecting United States' interests, showing the flag, etc. Such similar service as they do is not of great value, but suppose it as great as would be the value of the services of one-fourth those crews if they were released from training. That would leave enough officers and trained men to man several ships at a time when we are greatly in need of a larger personnel. The cost of maintaining that cruising training-fleet, and of building and fitting up the new ones now proposed, will be a large item in our future yearly expenditures. Will we be getting our money's worth? Will we ever in the long run get as much for our money as possible?

Our training-ships are now places where a great amount of hard, ding-dong work is conscientiously performed with the greatest thoroughness possible under the disadvantages inherent in a small crowded ship; any system, however poor, will give fair results when it is carried out with such spirit. Is the energy that carries that work through in the face of those disadvantages well expended? Not losing sight of the fact that any training system would also cost men and money, I think that an efficient one could be devised which would give good results and release enough of the personnel now occupied in training to properly stop some of those gaps for which we now have to temporize with makeshifts. In a navy where we do all other things in the most direct way, we go a long, expensive way about to train men for duty on modern ships, particularly if the training is done on a sailing ship. Conditions in our navy are of necessity different from any other, and there are more difficulties to surmount in manning it. Considering the good mental calibre of our recruits, the necessity of getting much useful service out of them in their short enlistments, and of inducing reënlistments and a good supply of high-class recruits by having an attractive service, sail and spar training is less suitable for our navy than for any other. The cruises of our training-ships to European ports, in spite of the value claimed for them in the way of attracting recruits, are in themselves damaging; we don't wish to coerce men to enlist—if they enter the service with their eyes open, in the desire to see that part of the world, they will probably leave when the cruise is ended. They never see as much as they expect and are disappointed; much more real training could be done in our own waters.

The navy has at present shore stations for training apprentices at Newport and at San Francisco, and the station at Port Royal has recently been utilized as a landsman training station. The climatic conditions at two of those stations might be better, but they afford

enough facilities for the course of training I advocate; which is merely the present course at Newport broadened and extended. The question is somewhat complicated by the two classes of recruits we now take, apprentices and landsmen. The apprentices should not be sent to a cruising ship until they are not only mentally capable but are well enough developed in body to be useful. The landsmen are more mature, are large enough for the work at any time and a course of fixed length could be laid out for them, whereas we would have to wait for the apprentices to grow up, which would make the length of the course indeterminate. If only one age-limit be used it will simplify the matter. The recruits for a class should arrive at the station in a body, and in time to take up the course at the date fixed for beginning work. The length of the course will depend on the thoroughness of preliminary training thought necessary. I think six months will be enough and still leave time for the transfers and preparations for receiving the next class.

All the members of a class, who from day to day prove their fitness, should be put through the course in a body and should complete it at the same time. In laying out the course, the climatic conditions at the different stations must be taken into account, and the work so laid out that the weather is not likely to interfere. It would also be well if the different stations finished their courses at different times of the year to provide for a smoother flow in the supply of trained men. The course should afford first of all plenty of infantry and field artillery drill; not only because it is essential in first producing strict discipline, but because it will be the best opportunity for teaching the recruits a very necessary part of their profession. The object should not be merely to teach them how to appear well on parade, but the drill should go as far as to include scouting, making camp and the whole line of work done on a campaign. An important part of a sailor's work is likely to be done with a ship's landing party, and our men are not habitually up to the work; I know of few men who would be at all reliable as scouts. A representative ship's battalion would be a dismal failure if called upon to make a simple frontal attack on any position; since few of the men would be able to estimate their ranges and have never done that kind of shooting, they wouldn't make many hits and would not take advantage of cover as every man must now do for himself, it being no longer possible for officers to pace up and down behind the line and tell their men just what to do. Ability to thus take care of himself on shore calls for a good amount of personal initiative and independence of thought in a sailor, and some of those qualities should soak in while he is under such training on shore. That part of the training will do much of what is claimed for seamanship in the way of development and the ability acquired by it will satisfy a want sorely felt on our ships that have to land men. Another most prominent part I would assign to work in boats. After the recruits can pull well and can handle themselves in a boat, teach them to handle boat sails and then give them charge of the boat in turn; if bringing them close to danger is worth the risk of sending them out in bad weather, it will prove such a former of character as the same time spent in carefully

watched work with ship's sails can never be. Minute instruction in care of the person and of the clothing, gymnastics, thorough grounding in target practice, and drill with single sticks, pistols and such kindred drills still thought of value on cruising ships would complete a good shore training. However, our present cruising training-ships would be available as station ships and they could be utilized for great gun drill, subcalibre practice under way, etc., to any extent desired. Recruits put through such a course with thoroughness should have an excellent start in their education. If, however, square-yard seamanship *will not* be dethroned, much of it could be learned on the station ships; if work underway be insisted upon, in spite of the expense in men and money and uncertain results, I propose that cruises as short as possible be made; that the ships with all their accounts be permanently attached to their respective stations and do their cruising in the vicinity; for example, the Newport ships would cruise in and about the Sound in summer.

We are at the present reviving the system of commissioning new ships for a three years' cruise, with the intention of keeping the officers and men who commission them on them for that time; such a ship will be given some time to get shaken down in before she is called upon for service. Suppose her allotment of officers, petty officers and long-service men only are at first put on board and are given an opportunity to learn their ship and each other; and then enough of our shore-trained recruits to fill her complement be sent aboard. Endless drills peculiar to her type would at first be in order for all hands, and if the organization and plan of the work to be done is in the first place prepared, the drills will not be difficult to learn. In ordinary routine work the recruits would have plenty of experienced men to follow and, being adaptable Americans, would soon do well. A great deal of routine instruction in their particular duties on the ship will be required, but, if the newly commissioned ship could thus be given a small amount of time in which to find herself, she would give excellent service for the majority of three years and could easily digest such recruits as would be needed from time to time to make up the inevitable waste. She would day by day be becoming more efficient with a crew brought up in part by her own officers, who would know that its quality largely depended on their own exertions and interest in their men. I once heard some officers of one of our newly commissioned battleships say that they had green men and were glad of it because they could mould them to suit themselves if they had a little time to do it in. This in fact would in part be a reversion to the old days in which each ship trained her own crew, and when the navy made such a glorious record. Perhaps, owing to the lack of the "sea-habit," the ship on first going to sea would have much seasickness and would be exceedingly inefficient until it was over; the same state of affairs exists to as great a degree on our training ships, but nothing ever permanently goes wrong in consequence.

So extended a system of shore training would require more officers and men at the stations than are allowed at present, but by discontinuing the cruising training service—by far the most expensive link in the

chain—many times the additional number required on shore would be released for it and other duty. If the necessary number of officers and competent men be sent to those stations we shall find sufficient character in the recruits they produce—as a matter of fact we can find young men who already have it if we only recruit in the right districts—and at the same time those recruits will receive direct instruction in what they will have to *know*.

We have lately arrived at training firemen in a modern cruising ship; it is not at all an extension of the old system, for they are being instructed in exactly what they will do throughout their naval careers. Another side of the question of training is the proper method of and the attention that should be paid to training petty officers. They are not, as a class, very satisfactory now, and great effort must be made to produce and maintain an efficient corps of them, for they would be the real backbone of the service, and with them we will not do so badly even if great numbers of Americans do *not* show a desire to remain with us as seamen, or below, for many enlistments.

To sum up the facts partially set forth in the above: An old-fashioned square-yard man-of-war's man is a handy man on any ship for various reasons; such a man cannot be made in six months; considering the point of view of our present class of recruits, sail and spar training is not theoretically the best system; even if it can be shown to be best in theory, it is no longer practicable; our term of enlistment being necessarily short, the apprentice system does not efficiently man our ships and by it we do not get the best value for our time and money; naval recruits for the seaman branch should be of more mature age on first enlistment; it will be best to discontinue cruising training-ships and do all training at shore stations and in regular service; if cruising training-ships be not abolished, the next best thing will be to attach them to the several stations and have them cruise as near as practicable to their respective bases.

The writer has had an experience of over three years in the training service, which has for the most part been pleasant duty; his excuse for writing is his belief that many officers have these ideas and that it would be good for the service if they would express them; most of the active workers at present vote the other ticket.

"Modern Naval Training."

Lieutenant Dudley W. Knox, U. S. Navy.—The problem of properly training recruits, so vital in its importance to a navy, has been publicly discussed of late years both at home and abroad. The recent agitation of the question in England led to no end of controversy both in their navy and out of it; and a short time ago when discussion was invited by our own Navy Department, widely varying views were found to exist among officers of the highest professional standing.

There are two schools advocated which may be termed the "old" and the "new," differing essentially in the type of ship in which the recruit is first sent to sea for training. The former maintain that the sailing ship is a means to character formation and the development of

certain qualities, viz.: adaptability, courage, resourcefulness, handiness, activity and strength—which are essential to the finished man-of-war's man; and that these qualities cannot be developed to a satisfactory degree on the steamer alone. Complaint is heard from the "new" school that valuable time is lost on the intricacies of a sailing ship which might be better employed in learning those of a modern man-of-war; that the sailing ship develops clumsiness of a kind fatal in handling the delicate auxiliaries and appliances on a modern ship; and that the qualities of military bearing, precision and "exact discipline," as well as mechanical ability and dexterity, are given a serious setback. In a word that the sailing ship does not start the training in the direction followed by the later education of the recruit; thereby not merely ill-fitting him, but actually giving him a decided setback in his preparation to meet the demands of the present and future in the service.

There are strong points to both of these arguments. The qualities desired by both sides are of the greatest importance. The weak point of each school consists in its failure to develop satisfactorily the qualities deemed of highest value by the other.

Could we but evolve a training system by which all the qualities considered by both of such great importance would be developed to a high degree, the service would be greatly benefited.

The widely read and much-discussed letter of Captain F. E. Chadwick, U. S. Navy, published in the Naval Institute Proceedings at the request of the Chief of Bureau of Navigation, is most convincing in its argument, if its statement be true that the sailing ship is a far better school for acquirement and development of the qualities he mentions, than any other in the world. But is it not possible to develop those same qualities in equal degree, in another school which advocates "tools" more in keeping with modern service afloat? one in which those valuable qualities advocated by the "new" school can also be developed.

If such a school can be evolved, then the older school must in reason give way to the new.

Let us consider the qualities mentioned by Captain Chadwick: courage, resourcefulness, activity and strength.

The two last, namely activity and strength, can be developed without difficulty to an entirely satisfactory degree by more modern means than the sailing ship. The barrack system, now fairly established in our service, permits ample opportunity for development of these two qualities before the recruit is sent to sea. Here he may be given all sorts of gymnastics ashore, together with plenty of infantry drill and exercise in boats under oars. The value of gymnastics has never been really understood in the navy. We can learn much from the army on this subject. An investigation of the attention devoted to them at West Point, and the methods employed at that place for physical development, would prove highly interesting and instructive to most naval officers. During his first year every cadet is carefully watched and trained by a professional trainer, who devotes more time to the timid weakling than to his more active mates; thus producing a most satisfactory standard. The result at the end of a year is truly remarkable. Ath-

letics were in high favor also at all army posts before the Spanish-American War, and looked upon as an essential part of the training of a soldier, and the results justified the means, for no better army ever existed in point of strength, activity and endurance than our regulars at that time. We have the same opportunities with our own recruits in barracks; and after they are sent to sea, the usual routine of drills and exercises is pregnant with possibilities of physical development which can produce a man physically equal to the product of the sailing ship.

Courage can be highly developed only by familiarity with danger. I question whether this element enters more into the life on board a sail training-ship, whose itinerary is selected with a view to meeting with the best of weather, than it would into the life on a steamer where the crew was given constant exercise in all possible weather, with boats under sail, landing through a surf, and lowering and hooking on boats at sea. Target practice with great guns is also something of a courage tonic. While the actual danger is small, one is apt to imagine more—particularly a recruit—and this exercise is far more fruitful of permanently valuable results to a man-of-war's man than sail drill. Let the training-ships during a passage at sea give plenty of this practice, and they will not only stimulate the courage of the recruit, but will also lay the foundation for good marksmen.

No one can gainsay the fact that service in a sailing ship develops resourcefulness to a high degree; possibly to a higher degree than can be gotten by any other means, but we have not yet given our other means at hand a fair trial. Boat sailing is an excellent school for this as well as for courage and for constant readiness for emergency. Where have we a more resourceful and courageous set of men in the country than the boatmen and fishermen of our coasts? Transporting and carrying out anchors, handling heavy weights of all kinds, countermining, clearing foul anchors, infantry operations on varied ground, and a multitude of other exercises, furnish a field for the development of this quality. None of them taken alone can compare with the sailing ship in developing resourcefulness, yet when constant drill is given in all of them, we can certainly hope to get as good results as we can get from the sailing ship, limited as we now are to the time that can be spared to it, and handicapped by the growing lack of interest of both men and officers. One point that must not be overlooked is the fact that the *type* of resourcefulness acquired on a sailing ship differs very materially indeed from that necessary in a dynamo-room or turret, and it is only through experience in these places that one can acquire the kind of resource required there. The driver of a marine engine has as great a demand made upon his resourcefulness as the captain of a top aloft. For the development of this quality, then, we could logically decide that service in the engine-room should replace service with masts and sails.

We can therefore conclude that it is possible to evolve a system of training which is equal to the sailing ship for character formation and development, employing only modern drills in its application. Many, no doubt, are slow to become convinced of this. Possibly the con-

clusion is not true when the sailing ship is used to its very best advantage, like we propose to use our modern methods; but it must be remembered that interest in the old ships is fast dying out. The recruits themselves feel that it is but a waste of time in their education, and are eager to get on board modern ships. Zeal, enthusiasm, and even interest, are lacking, and without these we cannot hope to accomplish much. The younger officers in the service can never become nearly so proficient in working ship as their elders are, and therefore they can never take the same interest in that branch of the profession. We youngsters must endeavor to attain the highest possible efficiency in a number of other difficult and intricate branches far more essential to the officer of to-day, and to do this something must be neglected. For the good of the service let it be that which is already out of date.

It may be possible to keep a smart sailing ship squadron in commission for ten, twenty, or thirty years—after that where are the commanding officers coming from? The sailing ship is doomed, and the sooner we drop it and begin in earnest the development, for training, of an efficient substitute, so much sooner will we profit by the step.

PROFESSIONAL NOTES.

Prepared by Lieutenant E. L. BEACH, U. S. Navy.

For convenience of reference these notes are arranged as follows:

A. Notes on ships of war, budgets, and personnel, the notes appearing under the head of the naval power to which they refer. Alphabetical arrangement is followed.

B. Miscellaneous Notes on Armor, Ordnance, Explosives, Torpedoes, etc. The arrangement is alphabetical and the principal heads are:

1. Ammunition.
2. Armor.
3. Boats.
4. Boilers.
5. Coaling Ship.
6. Engines.
7. Gunpowder and Explosives.
8. Guns.
9. Liquid Fuel.
10. Instruments Used in Action, etc.
11. Torpedoes.
12. Wireless Telegraphy.

SHIPS OF WAR, BUDGETS AND PERSONNEL.

ARGENTINE REPUBLIC.

VESSELS BUILDING.

Name.	Displacement, tons.		Remarks.
Armored Cruisers.			
General Mitre.....	8,500	.....	Proposed. Not ordered.
General Roca.	8,500	....	" " "

ARGENTINA.

The recent Argentine naval manœuvres held off Bahia Blanca are said to be the most important that ever took place in South American waters. Five armored ships, four cruisers and four destroyers took part. It is stated that the ships were well handled, both in squadron and individually, and that the gun crews showed the effects of commendable training.

A SOUTH AMERICAN DRYDOCK.—The *Buenos Ayres Standard* describes a new naval graving-dock of monumental dimensions, built at Bahia Blanca, Argentina, under the supervision of Luigi Luigigi, an Italian engineer. This drydock is large enough to admit the largest vessel afloat. It can be divided into sections to suit ships of different sizes, or to permit the docking of two ships at the same time. The *Standard* gives the following figures as to its dimensions: It is 100 feet longer than the dock at Talcahuano, 20 feet longer than the graving-docks in construction in the dock-yards of Devonport, the most modern in England; 3 feet longer than the four graving-docks in construction in the dock-yards of the United States, and 8 feet longer than the largest graving-dock at Spezzia. It is the largest graving-dock in America and may be said to be the largest naval graving-dock in the world. It can

be filled with 50,000 tons of water in 40 minutes, and can be pumped dry in 2½ hours. The sliding caisson may be opened or shut in three minutes by hydraulic machinery. In its construction were employed 75,000 cubic meters of concrete; 15,000 tons of cement; 6000 tons of granite (facings and copings), and 1500 tons of iron-work (caissons, pumps, etc.).—*Army and Navy Journal*, March 22, 1902.

AUSTRIA.

The total estimates for 1902 are $9,474,340.

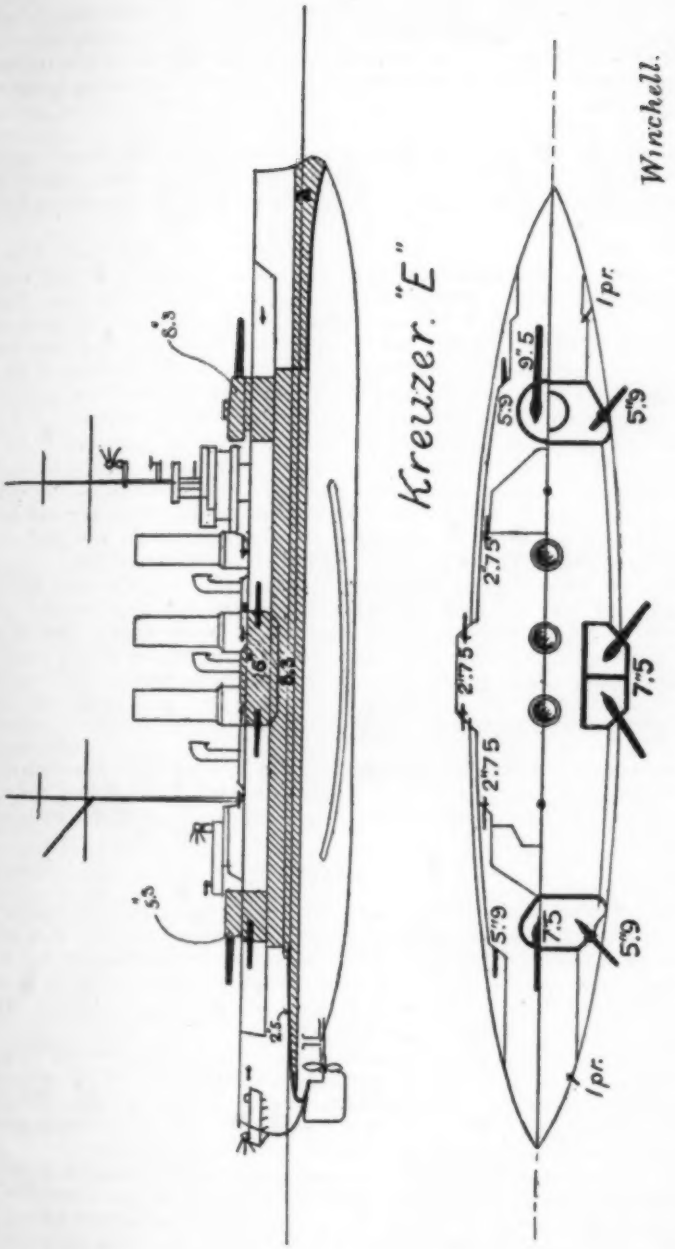
VESSELS BUILDING.

Name.	Displacement, tons.	Where Building.	Remarks, date of completion.
Battleships.			
A (ersatz-Loudon).....	10,600	Trieste.	Building.
B (ersatz-Drache).....	10,600	"	Ordered.
Babenberg	8,340	Pola.	Building.
Arpad	8,340	Trieste.	"
Hapsburg	8,340	"	"
Armored Cruiser.			
E (ersatz-Radetzky)...	7,400	Pola.	"
Protected Cruiser.			
Szigetvar	2,350	"	
River Monitors.			
I.....	480		
II.....	480		

The new battleships are to be fitted with Yarrow boilers.

BUDGET.—The discussion in the Military and Naval Committees of the Austrian Delegations have promised to be animated; especially in connection with the credits to be asked for howitzers and mountain guns of a new type, and larger instalment for experiments with new field guns, preparatory to a very large credit, next year, for the rearmament of the field artillery. The additions to the navy will, as usual, be of very modest dimensions. Further instalments are asked in the Naval Budget for the construction of the battleships A and B, and a first instalment for a sister-ship C. These three vessels, each of 10,600 tons, are meant to form a homogeneous division. The instalments for a cruiser of 7000 tons, for two Danube monitors, and five patrol boats also for the Danube and, lastly, for the construction of a new dock at Pola, will be the same as last year. An additional sum is for naval manœuvres, the first series of which will begin on June 15, and last to the end of August, when the Emperor will be present. The total increase in the Naval Budget for 1903 will not be more than about 3,000,000 kronen, or less than £150,000. The *France Militaire* states that experiments have been recently made at Fiume with a new Austrian submarine boat invented by a Croat named Czentkovic. The boat is said to move easily in any direction in the water either in the vertical or horizontal plane. The results of the trials are at present kept secret by the Austro-Hungarian Government.—*Army and Navy Gazette*, May 17, 1902.

FLOATING DRYDOCK.—A new floating dock with an elevating power of 15,000 tons is to be built at Pola, its length being 460 feet, its height 46 feet, its breadth 115 feet. It will be in three portions, each of which can be used separately in case of need.


Kreuzer "E"
Winchell.
8.3
5.9
6"
8.3
5.9
2.5
9.5
5.9
1 pr.
5.9
2.75
2.75
2.75
7.5
5.9
7.5
5.9
1 pr.

At the San Maico yard, the battleship "A" of 10,600 tons is being built; at Pola the armored cruiser "E" of 7200 tons is being built. The battleship "B" is soon to be laid down. For the construction of these three vessels a sum of 5,900,000 crowns is to be expended during the present year.

ARMAMENT OF NEW BATTLESHIPS.—It has been announced that the battery of the new 10,600-ton Austrian battleship, recently ordered, will consist of four 9.4-in., eight 7.5-in. Q. F., six 6-in., and 28 smaller caliber guns.

The new armored cruiser, E (see plans on preceding page), which is to replace the Radetzky, has been laid down. E might well be considered a second-class battleship. Its displacement is 7400 tons; length, 384 ft.; beam, 61 ft. 8 in.; draught, 21 ft. 4 in.; speed, 21 knots with 12,300 I. H. P. E is protected by an armor belt extending from turret to turret, the maximum thickness of which is 8.2 in., tapering to 6½ in. at the lower edge, and by thinner armor to the height of the main deck. In the forward turret, which is protected by 8.3-in. armor, two 9.5-in. guns are mounted. In the after turret, which is protected by 5¼-in. armor, only one 7.5-in. gun is mounted. Four 7.5-in. guns are mounted on the main deck amidships, two on a side in an armored casemate, this casemate being divided by an armored bulkhead. There are four 5.9-in. Q. F. guns mounted in casemates on the main deck, and 25 guns of smaller caliber. The cost when completed will be $2,391,380.

Reports from Vienna state that Mr. Czentkovic, a Croatian inventor, has constructed a submarine boat that can proceed with the same speed either ahead or astern, at the surface, or submerged. The Austro-Hungarian Government has appointed a commission before which, at Fiume, the trials of this submarine boat are to be held.

BRAZIL.

It is reported that the government has appointed a committee to investigate and report upon the submarine boats, one of Gomez, the other of Marques, type. These were described on page 752, PROCEEDINGS No. 100.

CHILI.

The Chilian government has ordered two battleships, or perhaps armored cruisers, to be constructed in England. Each will cost, armed and equipped, about $5,000,000. They are to be 435 ft. long, with 70-ft. beam. The engines are to develop 25,000 horsepower, giving a speed of 21 knots. Each ship is to carry four 10-in. guns, fourteen 7.5-in. guns, and many smaller rapid-fire guns.

There has been much discussion recently in Chilian journals, as to the comparative naval strengths of Chili and Argentina. This was caused by the action of the Chilian government in offering two ships, the Presidente-Pinto and the Presidente-Errazuriz for sale, a movement greeted with so much opposition that the ministry resigned.

It is reported that Chili has purchased abroad three torpedo-boat destroyers, which have been named Capitan Thomson, Capitan Merivo Tarfa, and Capitan O'Brien. It is not known at present writing just what these boats are, or where or from whom they were purchased.

FRANCE.

VESSELS BUILDING.

Name.	Displacement, tons.	Where Building.	Remarks; date of launch; probable date of completion.
Battleships.			
A[11]	14,865		
République	14,865	Brest.	
Patrie	14,865		
Suffren	12,728	Brest.	Launched; nearly complete.
Iéna	12,052	"	Practically completed.
Henry IV	8,948	Cherbourg.	Lchd.; practically completed.
Armored Cruisers.			
Ernest Renan	12,550	Brest.	Ordered.
Jules Michelet	12,550	Lorient.	Ordered.
Jules Ferry	12,550	Cherbourg.	Not yet lchd.; complete 1904.
Victor Hugo	12,550	Toulon.	" " " "
Léon Gambetta	12,550	Brest.	Lchd. Oct. 26, 1901; compl. '04.
Jeanne d'Arc	11,270	Toulon.	Launched 1899.
Gloire	10,014	Lorient.	" 1900; compl. 1903.
Marseillaise	10,014	Brest.	" " " 1902.
Amiral Aube	10,014	St. Nazaire.	Lchd. May 9, 1902; compl. 1903.
Sully	10,014	La Seyne.	" June 4, '02; " "
Condé	10,014	Lorient.	Lchd. Mar. 12, '02; compl. '03.
Amiral Gueydon	9,516	"	Launched, 1899; compl. 1902.
Dupetit Thouars	9,516	Toulon.	Lchd. July 5, 1901; compl. 1903.
Montcalm	9,516	La Seyne.	" Mar. 28, '00; compl. '02.
Desaix	7,700	St. Nazaire.	" Mar. 21, '01; " '03.
Dupleix	7,700	Rochefort.	" Apr. 28, '00; " '03.
Kléber	7,700	Bordeaux.	Not yet launched; compl. 1903.
Protected Cruisers.			
Jurien de la Graviere	5,500	Lorient.	Launched, 1899; compl. 1902.
Chateaurènault	6,018	La Seyne.	Not yet accepted; machinery unsatisfactory.
Transport.			
Vaucluse	1,650	Rochefort.	Launched; complete 1902.
Torpedo Boat Destroyers.			
Pertuisane	303	Rochefort.	Lchd. Dec. 5, 1900; compl. '02.
Hocpette	303	"	Lchd. Dec. 20, 1900; compl. '02.
Flamberge	303	"	Lchd. Oct. 28, 1901; compl. '03.
Hapière	303	"	Lchd. July 16, 1901; compl. '02.
Sarbacane	303	"	Laid down 1901.
Carabine	303	"	" "
Francisque	303	"	Ordered.
Sabre	303	"	"
Arquebuse	303	Havre.	Complete 1903.
Arbalète	303	"	"
Mousquet	303	"	"
Sagaie	303	"	"
Epieu	303	"	"
Harpon	303	"	"
Fronde	303	"	"
Javeline	303	"	"
Bombarde	303	"	"
Catapulte	303	"	"
Dard	303	(?) Rouen.	Ordered.
Baliste	303	(?) "	"
Mousqueton	303	Chalons.	"
Arc	303	"	"
Pistolet	303	Nantes.	"

VESSELS BUILDING—*Continued.*

Name.	Displacement, tons.	Where Building.	Remarks; date of launch probable date of completion.
Bélier	303	Nantes.	Ordered.
M_{32}	?	Rochefort.	"
M_{33}	?	"	"
Torpedo Boats.			
Rafale	162	Havre.	About completed.
255, 256, 257	906	"	" "
259, 260, 261	90	Bordeaux.	" "
262, 263	86 to 90	Chalons.	" "
264, 265	90	Bordeaux.	" "
266, 267, 268	87	?	Ordered.
269, 270	91	Havre.	"
271, 272	89	Chalons.	"
273, 274	91	Bordeaux.	"
275, 276	90	"	"
277	90	Saigon.	"
Libellule	40	Havre.	Building (turbine machinery).
Submarine Boats			
Farfardet	185	Rochefort.	About completed.
Gnome	185	"	" "
Korrigan	185	"	" "
Lutin	185	"	" "
Perle	70	Toulon.	Building.
Bonite	70	"	Building, ordered in 1901.
Esturgeon	70	"	" " "
Thon	70	"	" " "
Souffleur	70	"	" " "
Anguille	70	"	" " "
Alose	70	"	" " "
Dorade	70	"	" " "
Truite	70	"	" " "
Grondin	70	"	" " "
Naiade	68	Cherbourg.	" " "
Protée	68	"	" " "
Lynx	68	"	" " "
Ludion	68	"	" " "
Loutre	70	Rochefort.	" " "
Castor	70	"	" " "
Phoque	70	"	" " "
Otarie	70	"	" " "
Méduse	70	"	" " "
Oursin	70	"	" " "
Q_{25}			" " "
Q_{26}			" " "
Q_{27}			" " "
17 boats		.. Various places.	Building all completed by 1904.

FRENCH NAVAL ESTIMATES, 1902.

Personnel:

Admiralty office	£ 139,795
Navy pay	1,952,982
Marines (transferred to war department)	61,836
Gendarmerie maritime	27,804
Inspection of administrative service	11,413
Construction staff	226,017
Administrative staff, commissariat, etc.	265,753
Medical and religious staff	75,985
Fisheries and navigation	28,053

LABOR.

Wages:		
Shipbuilding; new construction; fitting for sea	£	476,127
Shipbuilding; repairs,		201,960
Master-attendant's and storekeeper's departments		246,933
Armaments; construction of new guns		127,236
Armaments; repairs		68,100
Works		26,691
Submarine defences		25,203
Victualling		34,389
Hospitals and miscellaneous		14,387

MATERIAL.

Stores and supplies:		
Admiralty	£	9,990
Shipbuilding in dockyards		1,561,345
Shipbuilding by contract		1,525,959
Fitting for sea; maintenance; repairs		768,987
Repairs, conversions, etc., in dockyards and by contract		651,842
Armaments; new guns and conversions; powder, ammunition, repairs, tools, etc.		1,052,040
Torpedoes		178,056
Works; new and large alterations		144,069
Works; deepening of charente		10,000
Works; supplementary for defence of military forts		439,854
Works; repairs		63,724
Hydrographic service		20,864
Clothing		151,848
Barracks		5,149
Victualling		831,852
Hospitals, etc.		79,304
Fuel, lighting, office furniture, printing, etc.		4,321

MISCELLANEOUS.

Travelling expenses, freight, allowance for lodgings, etc.	£	198,222
Charitable and subscriptions		39,199
Fisheries and commerce (material for protection, etc).		14,860
Pensions		466,908
Secret Service		4,000
Total		£12,271,947

—*Brassey's Naval Annual*, 1902.

FRENCH NAVAL MATTERS.—Shortly before the adjournment of Parliament last week M. Lanessan, Minister of Marine, succeeded in persuading the Chamber and Senate to vote two naval bills of the highest importance. The two laws, which went into force on March 2, authorize, between now and January 1, 1907, the expenditure of $132,000,000 for laying down new battleships and armored cruisers and $34,000,000 for the construction of drydocks, and for the building and improvement of coaling stations in France and at the French naval stations of Bizerta, Saigon, Diégo-Suarez and Dakar.

Since the Waldeck-Rousseau Ministry came into power, in 1899, no less than seventy-eight new vessels have been laid down. Most of these are still on the slips. Of this number there are two battleships, the République and the Patrie, both begun in 1901; four armored cruisers, the Admiral Aube, begun in 1899; the Jules Ferry and the Léon Gambetta, begun in 1900, and the Victor Hugo, begun in 1901; twenty destroyers, of which ten were begun in 1900 and ten in 1901; four torpedo supply ships, begun in 1899; twenty-five first-class torpedo boats, of which three were begun in 1889, ten in 1900 and twelve in 1901; thirty-one submarine vessels, of which six were begun in 1899, two in 1900 and twenty-three in 1901. The work on the submarines has been so pushed forward as to enable France to have, including the ten submarines already in commission, an efficient squadron of thirty-seven submarines by the year 1903.

An important reform accomplished by M. Lanessan is the separation of the purely military administration of the Ministry of Marine from the bureaus of construction and supplies. Hitherto the flag officer, who performed the functions of chief of the general staff of the navy, was at once director of the naval and civil cabinet of the minister, and executive chief of the officers and civil employes of the whole department. This extraordinary power and authority formerly enjoyed by the chief of staff have now been curtailed. The chief of staff is no longer the head of the minister's cabinet, and his functions have been subdivided into sections, each under a separate chief. The chief of staff is now intrusted with all that concerns the discipline, instruction and mobilization of the fleet. The administration of the services of armament, equipment and supplies forms a separate section under control of a flag officer, directly responsible to the minister. Matters pertaining to artillery and gunnery are placed in a third section. Torpedo boats and submarines form a fourth department. Naval construction forms a fifth department. Strange to say, all these heterogeneous functions had hitherto been grouped together in one administration under the exclusive control of the chief of staff. Decentralization is what M. Lanessan has accomplished, and in this he has carried out many of the ideas of his predecessor, M. Lockroy, to whom is due the credit of beginning the task of freeing the French naval department from the meshes and coils of red tape that in the last thirty years have thwarted genuine reform and prevented ministerial decrees from having more than a purely documentary effect.

The minister of Marine has thoroughly overhauled and reorganized the naval coast defences. Instead of the Director of Submarine Defences having control of torpedo boats, each port is to have an independent authority, amenable solely to the Maritime Prefect, and through him to the Minister of Marine. The supply of lieutenants and ensigns for torpedo boats and submarines being insufficient, the master pilots are to have the command of some of the torpedo boats. Hereafter torpedo boats are to be grouped in pairs, so as to assist each other in search of the enemy. The first torpedo boat of each group is to be under the command of a lieutenant or ensign, and the second under a master pilot.

At each torpedo station the force is to be divided into two parts, the first part kept fully manned, while the second will only have a crew sufficient to take proper care of the vessels. Only after contact with the enemy by the first division will it be followed up by the second division. The crews will be required to spend three months alternately on board the reserve torpedo boats and on board the active ones, the first di-

vision always to have a mobilization of at least five days at the end of each period of three months. Measures are to be taken to test and put on record each month the actual condition and endurance of the torpedo boats and submarines at each station, and also to register their sea speed. Numerous workshops are to be constructed all along the coast, to effect temporary repairs. This new organization is highly spoken of by the naval experts, and is expected to insure an extraordinary efficiency and development of naval coast defences along the whole length of the French seaboard, on the Atlantic as well as on the Mediterranean. The whole coast defence will thus constitute one separate department, intrusted to a vice-admiral.

A salient feature of the new naval construction programme is that far greater importance is attached to the great defensive fighting unit, the first-class battleship. M. Lanessan finds that the commerce destroyer theory, inculcated so vigorously by Admiral Aube, who was Marine Minister twelve years ago, has resulted in the building of an enormous number of swift cruisers, for which battleships have been sacrificed. M. Lanessan has come to the conclusion that this is not in keeping with modern requirements. The French naval authorities have more confidence than ever in torpedo boats, and are especially proud of their submarines, which are likely to receive still further development in the next two years.

Another radical reform effected by M. Lanessan is the new strategic grouping of the French naval forces in the East. The four hitherto independent naval divisions of the Extreme East—Cochin China, the Indian Ocean and the Pacific—have been abolished, and all placed under one command, called the Naval Force of the Eastern Seas. The vice-admiral intrusted with this important fleet will have two rear admirals under his orders, and the three principal stations of his force are Saigon, Diégo-Suarez and Nouméa. This new strategical organization will insure the rapid concentration of the vessels hitherto scattered about over nearly half a hemisphere, and will enable the vice-admiral at the head of it to fit out and dispatch with great rapidity any expeditionary force or special division of the fleet that sudden exigencies in the East may require. It is expected that this Eastern fleet, largely of cruisers, gunboats and destroyers, will form a splendid school of application for the younger officers. Four-fifths of the naval cadets, upon graduation from the course of instruction on the training ship Iphigénie, will hereafter be attached to the fleet in the Eastern seas, where they will have ample opportunities to learn to become self-reliant, and where they will obtain experience of command and responsibility—qualities that are apt to become rusty in junior subalterns attached to battleships or navy yards on the home station.—*New York Tribune.*

NEW BUILDING PROGRAMME.—The French programme contemplates that 37 vessels will be laid down and begun during the present year. These are to be four battleships of 14,865 tons, two armored cruisers of 12,550 tons, two destroyers, each of 303 tons, 16 first-class torpedo boats, and 13 submarines.

At the end of 1902 there will be under construction for the French navy 118 vessels; 6 battleships, 5 armored cruisers, 22 destroyers, 41 torpedo boats, and 44 submarines.

It will be remembered that Admiral Fournier lately paid a visit of

inspection to the French mobile defences. He appears to have reported that they are in an unsatisfactory state, and some friction seems to have arisen between the officers of the forts and the directors of submarine defences at the forts, under whose orders they were placed. Henceforth the mobile defences are to be independent, and subject only to the naval prefects in France and the naval commandants in Corsica, Algeria, and Tunis. Owing to the increase in the number of boats, lieutenants and sub-lieutenants are no longer available for all of them, and a strong objection has been raised to any increase in the lists which would bring about a block in promotion. It has accordingly been decided to group the boats of each of the mobile defences in pairs, one boat in each pair having a commissioned officer to command the group, while the second will have a warrant officer to be known as the *fatior*. A further division is into two categories, and the officers and men of the service will pass alternately three months in each. The first category boats will have full complements, and upon mobilization will make it their business to gain touch with the enemy, while the second division boats, which will have reduced complements, and will not be under constant training like the others, are being mobilized to take part in the operations. A vice-admiral being a member of the Superior Council of the navy, is to undertake a general and permanent inspection of these defences. Another arrangement is that new boats shall be so tested that officers in command of flotillas shall know the probable duration at which their speeds can be maintained. Two speeds are laid down, one being the cruising speed of fourteen knots, and the other the full speed, which is not to exceed nine-tenths of the maximum.

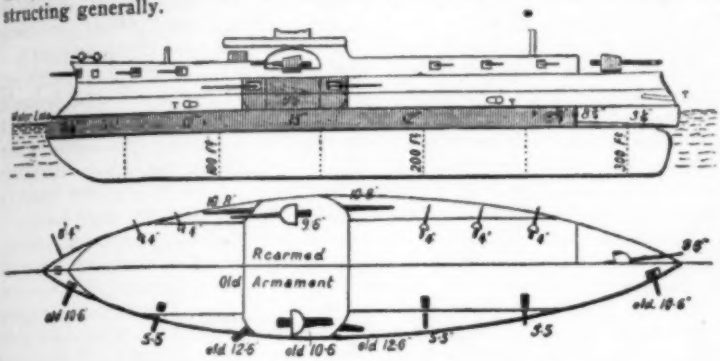
The mobile defences are also to be provided with factories, so that their branch of the service may undertake small repairs.—*Army and Navy Gazette*, April 12, 1902.

ADMIRAL AUBE.—The Admiral Aube was launched on May 9, at St. Nazaire. She is a sister ship to the Condé.

CONDÉ.—The Condé was launched on March 12. She was laid down at Lorient Jan. 29, 1901, and was launched 14 months later, 56 per cent complete. It is expected that she will have her trials in the latter part of next year. The celerity of her construction has given the French much commendable gratification. Her displacement is 10,014 tons; length, 453 feet; beam, 63 ft. 9 in.; draught, 24 ft. 7 in.; horsepower, 20,500. She is protected by an armor belt of Harveyized steel, 6.5 in. thick; her main guns are protected by 8.5-in. armor, and a further protection is given by a deck-plating 2 in. thick. Her armament is comprised of two 7.6-in., eight 6.4-in. Q. F., six 3.9-in., sixteen 1.8-in., and six 1.4-in. guns. She carries five torpedo tubes, two of which are submerged. Her designed speed is 21 knots. She can stow 1590 tons of coal; she is fitted with 28 Niclausse boilers; her complement, officers and men, will be 615. Her total cost will be $4,400,000.

THE FRENCH RECONSTRUCTED BATTLESHIP COURBET.—The Courbet, if her laying down be accepted as a criterion, is a contemporary of our Inflexible, for she was laid down at Toulon so long ago as 1876. She was, however, no less than six years on the stocks, her launch not taking place till 1882, while her completion for sea was nearly parallel with that of some of our Admiral class.

In design she approximates closely to our Alexandra, though always superior to that ship. In 1898-99 she was taken in hand for reconstruction, and from then till last year was reboilering, rearming, and reconstructing generally.



The result of these modifications can be best appreciated from the following table. In order to emphasize the meaning of the change, we have placed after each gun its war-game notation, as an index to its penetrative abilities:

	Old Courbet.	New Courbet.
Displacement, tons	10,200 (nominal)	10,800
Guns in battery.....	Four 12.6 in. (B)	Four 10.8 in. (A)
" in bow.....	One 10.8 in. (C)	One 6.4 in. (D)
" in stern.....	One 10.8 in. (C)	One 9.6 in. (B)
" over battery	Two 10.8 in. (C)	Two 9.6 in. (B)
" upper deck,.....	Six 5.5 in. (E), two 3-pdrs., twenty 1-pdrs.	Ten 4-in. (E), fourteen 3-pdrs., seventeen 1 pdrs.
Torpedo tubes.....	Five above water	Five above water
Broadside fire.....	Two 12.6 in. (B), three 10.8 in. (C), three 5.5 in. (E), one 3-pdr., ten 1-pdrs.	Two 10.8 in. (A), two 9.6 in. (B), five 4-in. (E) seven 3-pdrs., nine 1-pdrs.
Bow fire	Two 12.6 in. (B), three 10.8 in (C)	Two 10.8 in. (A), two 9.6 in. (B), one 6.4 in. (D)
Stern Fire.....	Two 12.6 in. (B), three 10.8 in. (C)	Two 10.8 in. (A), three 9.6 in. (B)
Engines.....	Compound vertical three-cylinder	Same as before.
Boilers.....	Cylindrical	Belleville
Indicated horse-power...	8100	8500
Speed.....	15.1 kts.	15.3 kts.

It will be seen how great an increase has been made in the penetrative power of the guns, and this, since the new fire far more quickly than the old, without any loss of shell power.

Nothing of note has been done to the Courbet's armor, which is still

her weak point. The belt is from 15 in. to 8¾ in. of iron, with a 3¼-in. compound deck on top of it. This deck is composed of a 2-in. iron deck with a 1¼-in. steel deck laid over it.

The redoubt is 9½ in. iron, with—as in all old ships—huge ports. To lessen the danger of these ports 4½-in. hardened steel shields have been fitted to the 10 8-in. guns. Whether these fulfil any useful purpose is a moot point; probably not, for the gap still exists. In addition, the 9½-in. iron armor is to be penetrated by an 8-in. gun, so the central battery's chances of survival are not brilliant. Still, since from an old ship of no value at all the French have evolved a vessel more than equal to our Admiral class, they may certainly claim to have accomplished something worth the doing, and as our Admiral class are still officially rated as first-class battleships, the Courbet may at least claim the same rank.

The dimensions of the Courbet are 318 ft. 4 in. long on the water-line, 69 ft. beam, and about 28 ft. draught—possibly rather more. She carries 900 tons of coal.

It may be added that some uncertainty exists as to whether 13.4-in. or 12.6-in, pieces constituted her old main armament. The difference, however, was immaterial, both pieces being on about a par with our 38-ton muzzle-loader. All the new pieces are guns of the latest model, 45 calibers long.—*The Engineer*, April 11, 1902.

GAMBETTA.—Work upon the armored cruiser Leon Gambetta, of 12,416 tons, is proceeding rapidly. There are to be axial turrets, each mounting two 7.6-in. guns, while the sixteen 6.4-in. quick-fires will be disposed four in angle casemates in the battery and twelve coupled in six armored turrets, of which four may be employed for low or stern fire. There will be in addition to this, twenty 1.8-in. and four 1.4-in. She will have Niclausse water-tube boilers, with triple screws, giving a speed of 21 knots.

JEANNE D'ARC.—The Toulon correspondent of the *Matin* telegraphs that the big cruiser Jeanne d'Arc, which recently left that port for its firing trials and to test the working of its turrets, returned to port after a series of trials which gave very bad results. These results are due to the vibration of the hull of the vessel, which are such that it will be impossible to sight the heavy artillery on board this long cruiser.—*The Engineer*, April 18, 1902.

JEMMAPES AND VALMY.—The coast defence battleships Jemmapes and Valmy have been sent to the arsenal at Brest for reconstruction. They are to have new guns and to receive better armor protection.

JULES-MICHELET.—The construction of the Jules-Michelet has been begun at Lorient in the place vacated by the Condé. The Ernest Revan is to be built at Brest. These armored cruisers were formerly known as C_{13} and C_{14}. They are of the Gambetta type, of 12,550 tons displacement, and of 22 knots speed.

THE TORPEDO ACCIDENT ON BOARD THE FRENCH BATTLESHIP JAURÉGUIBERRY.—Quite recently we made reference to the explosion of an air chamber in a torpedo on board the French battleship St. Louis. There has now been a second accident of the same nature on board the

battleship Jauréguiberry. As accidents of this sort are almost unknown in our service—the only thing of the kind being a case in which a torpedo hit a rock—some details of the latest French mishap may be of considerable interest.

The accident took place on January 22d, and resulted in the wounding of four men—one of them mortally. The following particulars are gleaned from the evidence tendered at the inquest on this unfortunate sailor.

The ship was about to exercise torpedoes and the crew of four were about the tube—an 18-in. one. The reservoirs of these are usually charged to 90 atmospheres, but before acceptance have to undergo a test up to 130 atmospheres or more. In this particular case, however, the torpedo was charged at 80 atmospheres only at the moment of explosion. It was apparently being charged at the time. It burst without the slightest warning, fracturing both thighs of the torpedo artificer, who was standing nearest it, and giving him a violent concussion, from the combined effect of which he died. The other three men farther away were chiefly injured by being hurled on deck through the shock and rush of air.

The explanation of the disaster given at the inquest was briefly as follows: The torpedo thus charged "was exceedingly fragile, owing to the immense pressure upon the interior of the air chamber," and that no torpedo in the French service when in this condition can be relied upon to stand a shock on the reservoir or its parts. By accident, or carelessness, this particular one was struck, the wall ruptured, and the explosion then ensued. Attention was drawn to a previous accident of a precisely similar nature on board the same ship. This was some years ago, and with a submerged tube. The torpedo in leaving the tube exploded, breaking the bar. So far as can be gathered from the somewhat conflicting reports that were current, this accident was attributed to the bar grazing the side of the air chamber. Last year's explosion in the St. Louis was attributed to a graze from the spoon—practically the same thing.

These three accidents give the impression that French torpedoes are exceedingly delicate things to handle. Like ours, they are of the Whitehead pattern. Most, or all, are made at the government factory at Toulon. This burst torpedo compares with ours as follows:

	Service British 18-in.	French 18-in.
Name	R. G. F. Mark V	45 cm.
Diameter	18 in	17.72 in.
Length	16 ft. 7½ in.	16 ft. 5 in.
Speed	31 knots	29.5 knots
Charge (guncotton)	175 lbs	198 lb.

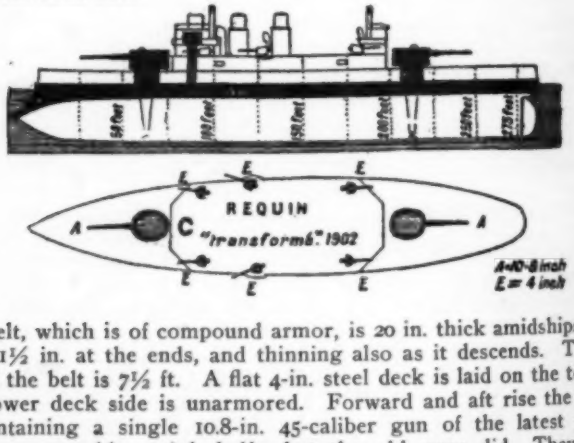
There are, unfortunately, no data as to the difference in weights, but it will be noted that the French weapon, though slightly the smaller, carries a considerably heavier charge in the warhead. The impression is that weight and strength are reduced elsewhere in order to allow of this. We used to be partial to an 18-in. Mark II Fiume, of 16 ft. 7½ in. long, that carried a 200 lb. charge, but it was discarded in favor of the R. G. F. Marks III, IV, and V. Mark V R. G. F. is a specially strong torpedo, entirely constructed of steel. No accidents have ever happened with it, and it requires no special care in the handling.—*Engineering*, Feb. 14, 1902.

THE FRENCH COAST-DEFENCE BATTLESHIP REQUIN.—A distinct point of difference between the French and British navies is the way in which the former rebuild and modernize old ships till they become equivalent to new vessels. Thus the old Requin had no fighting value at all—the reconstructed ship is fully equal, if not superior, to the Jémmappes and Valmy. Whereas two years ago the French navy counted but four coast defence ships of any utility, it will, two years hence, have added five more at no great cost—the four Requins and the Furieux, with which we shall be dealing on some other occasion. How complete the reconstruction has been can be gauged from the following table:

	Old Requin.	New Requin.
Actual displacement, tons ...	7600	7000
Main artillery	Two 75-ton 16.5 in.	Two 10.8 in.
Armor on it.....	17¾ in compound.	10-in. Harvey nickel
Armor at base.....	Small 8 in. hoist only.	10-in. Harvey nickel
Minor artillery	Four 4-in., 16 1-pdrs.	Six 4 in., ten 3-pdrs., four 1-pdrs.
Torpedo tubes.....	Two above water	None
Indicated horsepower.....	6000	6230 *
Maximum speed, knots.....	14.5	15.1 *
Boilers.....	12 cylindrical	12 Niclausse
Coal (normal), tons.....	400	400
Coal (maximum), tons.....	800	800
Armor belt, compound.....	20 in.; 11¾ in.	20-in.; 11¾ in.
Conning tower	3 in.	12 in.

* With ten boilers only.

This, however, by no means tells all the tale, for in the untreated ship all the belt was below the water. Now 2½ ft. of it stands above the water-line—a difference of some importance in a ship intended to fight only in smooth water. This is stated to be the result of lightening the ship by 600 tons odd.



The belt, which is of compound armor, is 20 in. thick amidships, tapering to 11½ in. at the ends, and thinning also as it descends. The total depth of the belt is 7½ ft. A flat 4-in. steel deck is laid on the top of it.

The lower deck side is unarmored. Forward and aft rise the turrets, each containing a single 10.8-in. 45-caliber gun of the latest pattern. These guns roughly weigh half what the old guns did. They are in

closed turrets, revolving on circular fixed bases of 10-in. Harvey nickel, all the machinery being inside these. The guns are electrically manœuvred. Their penetration and range are, of course, in excess of the old 75-ton pieces, the respective ballistics being:

	75-ton 16.5-in.	10.8-in.
Length in calibres	19	45
Initial velocity	1662	2625 foot-seconds.
Initial energy	17,000	22,750 foot-tons.
Weight of shell	1720	476 lbs.

Shot for shot, the old guns were infinitely more serious in their shell power, but the rate of fire was very slow indeed, while the high trajectory made hitting anything problematical. The new guns fire fairly rapidly and very accurate, the trajectory being very flat; their "danger space" is, of course, much larger. For one hit the old guns could have secured under battle conditions the new may expect to score ten or twelve—possibly more.

The old barbettes were very large and thick, though they gave the gun no more protection than do those of our Admiral class. These ships, indeed, are nothing but larger copies of the Requin class, as originally built, with more gun power, and all the armor gone from the ends. They could, perhaps by virtue of superior gun power, beat a non-reconstructed Requin, but matched against the Requin "*transformé*," there can be little question as to their inferiority. As the Admiral class still form the bulk of our Home Service Fleet, and the Requin will be in reserve for the French Channel fleet, the matter is one of considerable interest on both sides of the channel, and we cannot but pay a tribute of admiration to the resolution with which the French Ministry of Marine either rebuilds old ships or sends them to the scrap heap. What the French would do had they the misfortune to possess the Admiral class we can hardly venture to say. A Frenchman, asked about the matter, replied that it was "impossible to conceive of France building such ships"—which was a happy retort, but little else. Probably the French would no more have attempted reconstruction than our Admiralty—despite the advice of Lord Brassey—seem inclined to. On the other hand, they would never have retained them as units of their fleet—they would have sold them as old iron, built a cruiser out of the proceeds, and reckoned the bargain advantageous.

It is worthy of note that, in reconstructing the Requin, the French substituted for the two above-water tubes a couple of extra 4-in. guns on the topside—probably a wise step, for under modern fire men are hardly likely to be left standing at unprotected above-water tubes till torpedo range is reached.

Most of the superfluous woodwork has been taken out of the Requin during reconstruction. The appearance of the old Requin, Indomptable, etc., is familiar enough, with the two pairs of funnels in line abreast. These are still retained in the Indomptable, but the Requin having changed her boilers to Niclausse, has had new funnels placed, and bears very little resemblance to the familiar form. In these days of funnels a hundred feet high the stumpy funnels of the Requin are very noticeable. Of course, the lower the funnel the less the target, but this point seems lost sight of or disregarded in the enthusiasm for improved draught. Indeed, high funnels seem regarded as a necessity in all water-tube boil-

ered ships. As the Requin with only ten of her twelve Niclausses alight more than exceeded the contract indicated horsepower and speed, her short funnels seem to have been no inconvenience. Other things being equal, the boiler that can do with the minimum of target in the way of funnels is the boiler that all naval men will swear by.—*The Engineer*, March 21, 1902.

THE NEW FRENCH BATTLESHIP SUFFREN.—The Suffren represents a considerable advance upon previous French ships, and is of further special interest in that the standard type—the recently laid down Republique class—is evolved from her.

The principal characteristics of the Suffren are as follows:

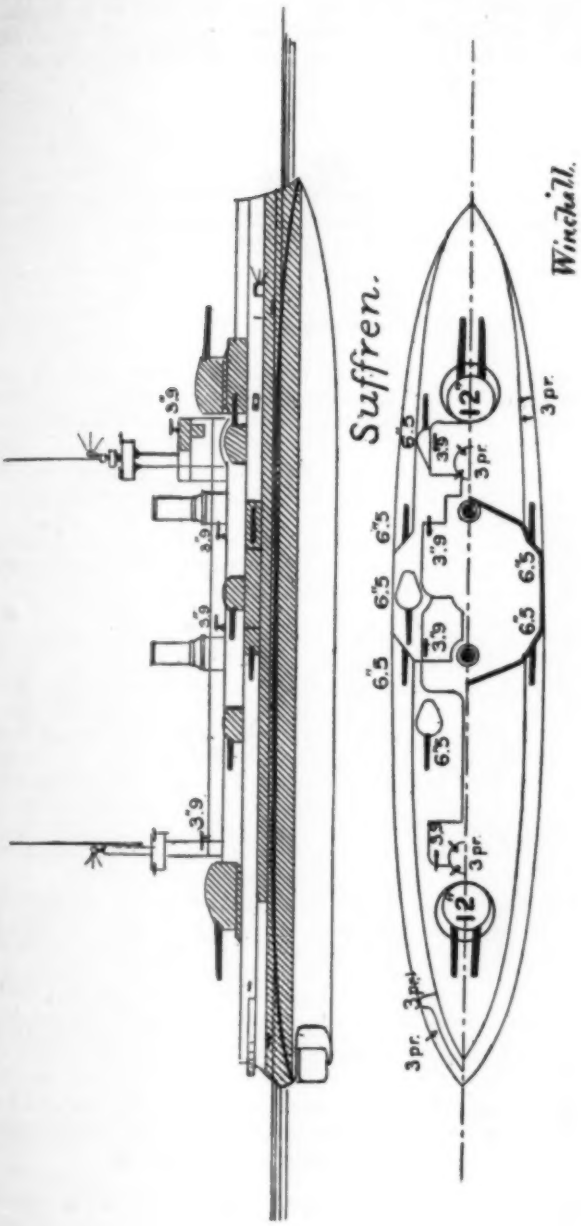
Displacement	12,728 tons.
Length	410 ft.
Beam	70 ft.
Draught	27½ ft.
Indicated horsepower	16,200.
Designated speed	18 knots.
Coal (normal)	820 tons.
Coal (maximum)	1150 tons.
Boilers	Niclausse.
Screws	Three.
Guns	Four 12-in., 40 cals.; ten 6.4-in., 45 cals.; eight 4-in., 45 cals.; twenty 3-pdrs.; two 1-pdr.
Torpedo tubes	Two submerged, two above water.

In addition to the ordinary fuel, liquid fuel is also carried. The armor, Krupp, is disposed as follows:

A complete belt 12 in. thick amidship on the water-line, reduced to 8 in. at the ends. On top of this belt is a flat 3-in. deck, at the bottom of it a second flat armor deck, the space between being entirely filled with coal.

The lower deck is protected from the bow by a belt 325 ft. long, 5 in. thick over the amidships portion, reduced to some 3 in. or so at the bow. Out of this upper belt rises the main deck battery, a 6-in. redoubt, mounting four 6.4-in. guns at its angles. This redoubt curves inward in such fashion as to completely enclose the bases of both funnels, thus serving the same end as the continuous battery of the Mikasa, or American ships. Thus far, it will be seen, the Suffren follows tolerably closely Anglo-Saxon ideas of construction, as opposed to distinctly French ideas. The only essential difference is that the very sound and complete French system of armor decks is adhered to, the complete belt being no longer a French specialty.

The rest of the Suffren is, however, fully French. The turrets, which are 12 in. thick, are essentially French. The heavy tower, common to British and American designs, is replaced by the usual French armored tube, which, in view of its thickness, is probably fully as efficient a protection as the huge erection we indulge in. The turrets themselves are


Suffren.
Windhall.
12"
6.5
3.9
3 pr.

balanced and elliptical, with those vertical sides to which the French consistently adhere, holding that—since shot fall at an angle—inclined plates will really offer less resistance than vertical ones. Along the upper deck are six turrets of 5-in. non-cemented Krupp armor, disposed as indicated in the plan.

Section of the Suffren.

The big guns have arcs of fire as follows: Forward turret about 210°, after turrets 270°. The fore and aft 6.4-in. turret guns all have arcs of 140° or more from the axial line, the amidships turret 180°, the battery guns from right ahead or astern to 20° abaft or before the beam. Each of the 4-in. pieces fires through an arc of 135° from the axial line. The submerged tubes bear on the broadside, the above-water ones are fixed to 45° abaft the beam.

The broadside and end-on fires are respectively: Broadside—four 12-in., five 6.4-in., four 4-in., one submerged tube. End-on—two 12-in., six 6.4-in., four 4-in.—*The Engineer*, May 9, 1902.

Bourrasque and Rafale.—After successful trials the torpedo boats Bourrasque and Rafale, built by Augustin Normand and Company, of Havre, France, were delivered to the French government. They are of the Cyclone unprotected class, with the following dimensions: Length on load line, 147 feet 6 inches; extreme breadth, 16 feet 7 inches. The weights carried on trial exclusive of chains, anchors, masts, boats, etc., and comprising only torpedoes, torpedo tubes, compressing pump, artillery, ammunition, provisions, water for crew and boiler, coal necessary for steaming 1020 nautical miles at 14 knots, crew and effects, amounted in all to 34.5 English tons in the Bourrasque and 39.2 tons in the Rafale, the displacements being 153.3 and 158 tons, respectively.

The full speed trials, which took place after the ordinary preliminary runs on the measured mile, were of four hours' duration. The first hour was to be run at 25 knots minimum, the next hour maximum speed, and the remainder of the time at 25 knots speed. The one hour maximum speed was 31.53 knots for the Bourrasque and 31.41 knots for the Rafale. The mean of the three other hours was 25.79 and 26.20 knots, respectively. The boilers are of the Normand type.—*Marine Engineering*, April, 1902.

Torpedo Boats Nos. 223 and 225.—These two torpedo boats have finally been launched, the former at Cherbourg, the latter at Havre. The former was ordered five and the latter six years ago.

Torpedo Boat No. 257.—Torpedo boat No. 257 was launched at Havre on February 14.

TYPHON.—The sea-going torpedo boat Typhon completed her trials in February, with great success. She is 152 tons displacement with 4200 I. H. P. The speed attained was at the rate of over 28 knots per hour.

SUBMARINES.—Recent reports state that a new periscope permits a submarine to survey the surface from a depth of 50 feet, while formerly to a depth of 20 feet. The new periscope is telescopic.

Reports from Paris state that the French government has just ordered the construction of 13 additional submarines. The specifications require that these are to be submergible within five minutes. The ease and certainty with which the Holland and her type can be totally submerged within less than five seconds would seem to give them much more extended spheres of possible offensive action, and much greater possibilities of safe attack.

ESPADON.—The submerged Espadon finished a series of official trials in March which were all very satisfactory to the French authorities.

SUBMARINES.—In the trials of French submarines at Cherbourg toward the end of January the Morse, Algerien, and Sirene attacked the Bouvines in the harbor, and two of them were able to discharge their torpedoes without being perceived. Another attack was upon the Cassini under way, and she is said to have been hit by two torpedoes outside the Mole. A few days later, when the Amiral Trehouart arrived at the harbor, she was attacked, it is said with success, by the Narval, Morse and Francais. There was a later attack upon the Bouvines, Trehouart and Cassini by the submergible boats Narval, Espadon and Triton and the submarines Morse and Francais. The three ships were patrolling before the openings to the harbor, as if to bombard the place and the correspondent of *Le Yacht* asserts that, out of the five boats, three discharged their torpedoes with success, and that the three assailants were hit. Commenting on the reports of trials the *Army and Navy Gazette* says: "These results were no doubt excellent, but we are not yet convinced that the vessels did not lay themselves open to attack by remaining near the mouth of the harbor. It is the interest of any vessel fearing submarines to steam as fast as possible, and often to alter course. The correspondent says that in such a case more submarines should be on the spot, so that a vessel in flying from one might fall a victim to the other, as is said to have happened at Cherbourg."—*Army and Navy Journal*, March 1, 1902.

SILURE.—The French submarine Silure has recently been submerged at a depth of about 140 feet. At this depth the pressure, according to reports, only compressed the boat $\frac{1}{25}$ inch. There is jubilation across the Channel accordingly; but what particular object is served by being at such depth is not very clear. It is about 110 feet below the bottom of the average battleship.—*The Engineer*, April 18, 1902.

GERMANY.

VESSELS BUILDING.

Name.	Displacement, tons.	Where Building.	Remarks.
Battleships.			
Wittelsbach	11,900	Wilhelmshavn.	Nearly complete.
Wettin	11,900	Dantzic.	Lchd. June 6, '01; compl. '03.
Zähringen	11,900	Kiel.	Lchd. June 12, '01; compl. '03.
Mecklenburg	11,900	Stettin.	Lchd. Nov. 9, '01; compl. '03.
Schwaben	11,900	Wilhelmshavn.	Lchd. Aug. 19, 01; compl. '03.
H	13,000	Kiel.	Laid down 1901.
I	13,000	Dantzic.	" " "
K	13,000	Stettin.	Ordered to be compl. by 1905.
L	13,000	Kiel.	" " " "
Kaiser Karl der Grosse	11,130	Hamburg.	Lchd. 1899; nearly complete.
Kaiser Barbarossa	11,130	Dantzic.	Nearly complete.
Armored Cruisers.			
Prinz Heinrich	8,868	Kiel.	Nearly complete; ready for trials.
Prinz Adalbert	9,000	"	Launched 1901; compl. 1903.
Ersatz König Wilhelm	9,000	Hamburg.	Nearly ready for launching.
Ersatz Kaiser	9,000	Kiel.	Building.
Protected Cruisers.			
Thetis	2,645	Dantzic.	Practically complete.
Ariadne	2,645	Bremen.	" "
Amazone	2,645	Kiel.	" "
Medusa	2,645	Bremen.	" "
G (Frauenlob)	2,645	"	Launched March 22, 1902.
H	2,715	"	" April 22, 1902.
I	2,645	"	Ordered.
K	2,715		Not yet ordered.
L	2,715		" "
Ersatz Zieten	2,715		" "
Gunboats.			
Panther	889	Dantzic.	Lchd. April 1, 1901; compl. '02.
B	?		Not yet ordered.
River gunboats	?	Hamburg.	" "
Torpedo Boats.			
S 102 to S 107 (6 boats).		Dantzic.	All launched; complete 1903.
G 108 to G 113 (6 boats).		Kiel.	Some launched; compl. 1903.
S 114 to S 119 (6 boats).		Dantzic.	Ordered.

GERMAN NAVY ESTIMATES, 1902.

ORDINARY PERMANENT ESTIMATES.

Imperial naval office	£ 80,481
Observatories	16,735
Accounts	19,512
Martial law	4,735
Divine service and schools	4,918
Military personnel	953,948
Maintenance of the fleet	1,075,305
Victualling	69,676
Clothing	17,346
Barracks administration, cashiers and accountants	57,507
Lodging allowance	146,490
Medical	69,984

Travelling expenses, freight charges, etc.	127,273
Training establishments	15,880
Dockyard expenses	1,116,160
Ordnance and fortification	366,212
Accountant-General's department	28,704
Pilotage and surveying services	26,628
Miscellaneous expenses	54,068
Administration of Kiau protectorate	2,648
Total of ordinary permanent expenses	£4,254,210

SPECIAL ORDINARY ESTIMATES.

Shipbuilding programme for the financial year, 1902. For the construction of—	
Battleship Wittelsbach (C), 4th and final installment	£ 118,012
Battleship Wettin (D), 4th and final installment	177,435
Battleship Zähringen (E), 4th and final installment	177,435
Battleship Mecklenburg (F), 3d installment	108,909
Battleship Schwaben (G), 3d installment	108,909
Large cruiser Prinz Adalbert (B), 3d and final installment	279,002
Battleship H, 2d installment	276,553
Battleship J, 2d installment	276,553
Large cruiser Ersatz König Wilhelm, 2d installment	245,227
Small cruiser G (Frauenlob), 2d installment	112,580
Small cruiser H, 2d installment	112,580
Small cruiser G, 2d installment	112,580
Alteration of vessels of Siegfried class, 2d installment	288,790
Battleship K, 1st installment	161,527
Battleship L, 1st installment	161,527
Battleship Ersatz Kaiser, 1st installment	186,001
Small cruiser K, 1st installment	61,674
Small cruiser L, 1st installment	61,674
Small cruiser Ersatz Zieter, 1st installment	61,674
Gunboat B, 1st installment	39,158
One torpedo-boat division, 2d and final installment	168,382
One torpedo-boat division, 1st installment	166,422
Other items	216,593
Total	£3,679,197

SUMMARY.

Ordinary permanent estimates	£4,254,210
Shipbuilding	3,679,197
Armaments and torpedo equipments	1,479,979
Other items	360,575
Extraordinary	460,107
Total	£10,234,068

REMARKS ON BUDGET.—A charge was made in the German budget of 800,000 marks for converting the corvette Marie, which was built at Hamburg in 1881, into a gunnery training ship. Another sum of one

million marks, is for fitting the Nixie as a training ship for cadets and the Sophie for the training of boys, these changes being made necessary by the loss of the Gneisenau. The Kronprinz is to be converted into a machinery hulk, at a cost of 800,000 marks.—*Army and Navy Gazette*, April 26, 1902.

REMARKS ON NEW CONSTRUCTION.—Commenting upon the activity of construction of German warships, the *Army and Navy Gazette* says:

Under the law of June 14, 1902, the fleet will comprise four battle squadrons and reserves, with ships for foreign service which require an establishment of 38 battleships, 14 large cruisers, and 38 smaller ones. The progress made in the building of battleships is very remarkable, and towards the 38 that are required 31 are already completed, in hand, or provided for.

It is true that in this number are comprised the Oldenburg, and the four ships of the Sachsen class, as well as the 8 coast-defence armor clads, all of which are to be replaced in due course, but it must not be forgotten that the ships of the Siegfried class are all being lengthened and reconstructed in such a way that they will possess relatively large coal capacity, and thus greater range of action. After the four ships of the Brandenburg class, come the five of the Kaiser class—the Friederich III Wilhelm II, Wilhelm der Grosse, Barbarossa, and Karl der Grosse—all vessels of 11,150 tons, well protected by Harveyized steel, heavily armed, provided with cylindrical and water-tube boilers, and having large coal capacity, and a nominal speed of 18 knots. Then come the five ships of the Wittelsbach class, the others being the Wettin, the Zähringen, Mecklenburg, and Schwaben, of somewhat greater displacement and higher speed. The new class, which has not yet been named, comprises so far from vessels of 13,000 tons, and much greater power. It is worthy of remark that they are all being built in private yards, and that a strong effort is being made to increase the shipbuilding resources of the country. The Germania yard at Kiel is being largely extended, and the Schichau establishment at Dantzic is practically new. "H" and "L" of the new class are being built at the Germania yard, the first of them to be launched in February, 1903, and the latter just beginning on the new ship, which is covered in with glass, enabling work to be carried on uninterruptedly in all weather. "J" is being built by Schichau, having been laid down in Dantzic in the middle of last year. "K" has been given out to the Vulkan yard at Stettin. It is not yet known whether a fifth ship will be added to this class, or what further plans are in hand. The 12 large cruisers which are to complete the establishment of ships, are already completed or in hand so far as numbers are concerned, but new vessels to replace the old König Wilhelm and Kaiser are in hand, and doubtless others to replace the Deutschland and the Hertha class, which are only protected vessels, will be begun. Like conditions prevail in the case of the 28 small cruisers of the establishment, the actual number being in hand, while others are being built to replace the older vessels. As a matter of fact "G," lately launched, which received the name of Frauenlob, is the 29th vessel of the class, according to the list. Evidently, therefore, the German navy has made very rapid progress, and is creating a large means for future extension. The emperor has accomplished his purpose, and has lifted his country to a notable place among maritime powers.

WIRELESS TELEGRAPHY IN GERMAN WARSHIPS.—The Slaby and Arco systems of wireless telegraphy are to be installed aboard all German warships.

BEOWULF, HEIMDALL AND HILDEBRAND.—These coast-defence battleships are being reconstructed at Dantzic and at Kiel. Their length is increased by 26 ft. 3 in., their displacement is increased; they receive new armor and a new battery, also the machinery and boilers will be removed. The Hagen is being reconstructed on similar principles. The work is being pushed by the German government, which intends that it shall be completed this year.

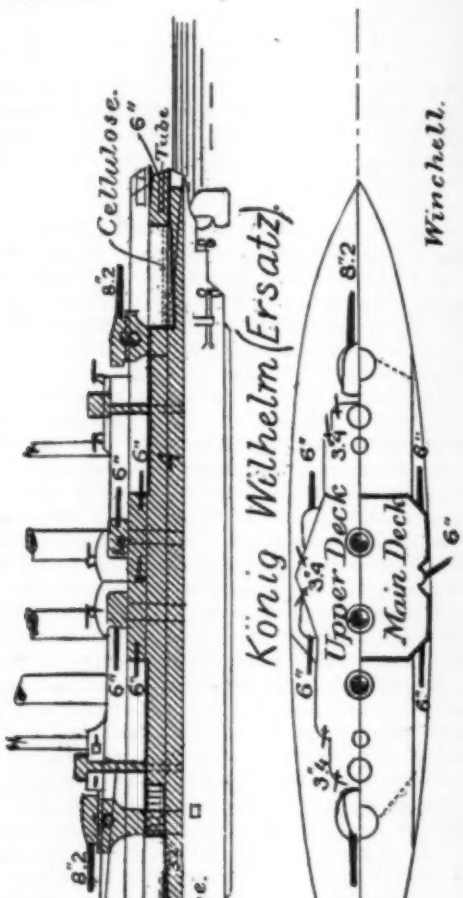
KÖNIG WILHELM (ERSATZ).—The plans of the armored cruiser which is to replace the König Wilhelm, and which is therefore known for the present as Ersatz König Wilhelm, are given on the accompanying page. This ship is a sister ship in all respects to the Prinz Adalbert, building at Kiel; the following description of the Ersatz König Wilhelm was originally given as a description of her sister ship the Prinz Adalbert, on page 600, No. 99 of PROCEEDINGS.

Description.—This vessel, formerly known as armored cruiser "C" (in the budget as 'Large Cruiser "C"'), is building at Hamburg. She is nearly a sister ship to the Prinz Heinrich, launched March 22, 1900, but differs in the battery and in some other particulars. The hull is of steel, without sheathing. There are two military masts, each carrying one top; and two smokepipes. The bow is high and the superstructure extends from the stem to a point just forward of the after turret. The complement is 528; or, as a flagship, 571. The principal details are:

Armament.—Four 8.27-inch Krupp guns in pairs in turrets forward and aft, the forward turret being on the superstructure (or upper) deck, and the after one on the main deck. These turrets are reported to be trained by hydraulic power. Ten 5.9-inch guns—three each side in a long casemate on the gun deck, forward pair firing directly ahead, and after pair directly astern; and four in four turrets, two each side, over the casemates for the 5.9-inch guns. The top sides are carried inboard to permit bow and stern fire from these turrets. Twelve 3.47-inch guns in the superstructure and on the upper deck and bridges. Four machine guns. Five submerged torpedo tubes: one through the keel, twenty or thirty feet abaft the point of the ram, and two each side. One above-water torpedo tube in the stern on the berth deck, protected by armor.

Protection.—Complete belt, 7.5 feet wide, 3.9 inches thick amidships, and 3.2 inches at the ends. Above this, and extending up to the gun deck for a length of 165 feet amidships, the side is covered with 3.9-inch armor; and above this again is the casemate armor of the 5.9-inch guns. The protective deck, behind the belt and sloping down at the sides to meet the lower edge of the latter, is 2.8 inches thick on the slopes and 1.6 inches on the flat. The flat armor deck over the upper side armor, outside the casemate, is 1.2 inches thick; and the deck over the casemates is 1.4 inches. The turrets for the 8.27-inch guns are 5.9 inches thick and rest on barbette towers of the same thickness. The forward tower only extends down to the main deck and the after one to the gun deck; thence loading tubes extend to the protective deck. The armor of the 5.9-inch turrets is 3.9 inches thick in front and 3.2 inches in rear, and of the 5.9-inch casemates, 3.9 inches. The forward conning tower

is 5.9 inches thick, and the after one 0.47-inch of special steel. The loading tubes for the 8.27-inch guns are 3.9 to 3.2 inches thick; for the 5.9-inch turrets, 3.2 inches.



Motive Power.—Triple-screw, 4-cylinder, triple-expansion engines, designed to develop 16,000 I. H. P. and give a speed of 21 knots. Four-

teen Dürr water-tube boilers. Coal supply, at load draught, 950 tons; total capacity, 1500 tons.

Dimensions.—Length, 393.7 feet; beam, 64.3 feet; mean draught, 24.3 feet; displacement, about 9050 tons.

THE NEW GERMAN CRUISER PRINZ HEINRICH.—The new German cruiser Prinz Heinrich is now so far completed that the trial trips can be begun shortly. The result of the trial trips is awaited with great interest, since this vessel represents an entirely new type not represented in the German navy, and as regards size and strength of armament and armor protection stands between the gigantic armored cruiser Fuerst Bismarck and the vessels of the Freya class.

The construction of the Prinz Heinrich was commenced in December, 1898, at the imperial shipyards in Kiel, and has therefore required a little over three years. The vessel is 393.6 feet long and 64.3 feet beam and, fully equipped, has a draught of 24 feet and a displacement of 8930 tons. Like all the other new large ships of the German navy, she has three screws driven by the like number of separately mounted four-cylinder engines with triple expansion. The maximum speed is calculated at 20.5 knots. The armament consists of two 24-centimeter (9½-inch), ten 15-centimeter (6-inch) and ten 8.8-centimeter (3½-inch) quick-fire guns, as well as ten 3.7-centimeter (1½-inch) machine guns. The two heavy guns are mounted in two revolving turrets forward and aft and have a free arc of fire of 270 degrees each. Of the ten guns of the secondary battery (6-inch caliber) six are placed in the casemate, three on each side, in such a manner that the two forward ones can also fire dead ahead and the two after ones dead astern. The other four stand in single revolving turrets one story above the casemate. The two forward ones of these can also fire dead ahead, and the two after ones dead astern. The lighter guns (8.8 and 3.7-centimeters) are placed on the upper deck and on the superstructures in such positions that each single one has as large an arc of fire as possible. Of the 3.7-centimeter (1½-inch) machine guns, some have been placed in the tops of the two fighting masts.

The torpedo armament consists of four tubes for 45-centimeter torpedoes, three of which (one bow and two broadside tubes) are submerged; only the stern tube protected by the belt armor lies above the water line. In the ships of the Freya class the stern tube is lacking.

As regards armor protection, the Prinz Heinrich differs from the vessels of the Freya class, especially in the belt armor, which extends over the whole length of the ship and is 100 millimeters thick on the water line. The turrets of the heavy guns have an armor thickness of 6 inches, as against 4 inches in the case of the other aforementioned cruisers. Of equal thickness as with these, viz., 4 inches, is the armor protection of the forward conning tower and of the 15-centimeter (6-inch) guns (casemate and turrets), but in the Freya class the casemate of the Prinz Heinrich is entirely lacking. The light guns only possess the protection, customary in the German navy, of protective shields affixed to the carriage bodies proper. Naturally all the ammunition shafts leading to the gun mounts are also armored.

The slightly arched protective deck, which in the case of the beltless vessels, Freya, etc., has a thickness of 4 inches, possesses with the Prinz Heinrich only a thickness of 2 inches, even tapering down to 1.5 inches.

The coal bunker capacity is very large—950 tons—as is consequently also the radius of action of the vessel, which naturally considerably increases her usefulness. The complement consists of 15 naval officers, 4 marine engineers, 2 doctors, 12 ensigns, 1 paymaster, 24 deck officers and 446 sub-officers and crew, hence altogether of 504. All the rooms of the vessel are provided with electric light, and the living rooms with steam heat besides.

Despite her gigantic dimensions, the Prinz Heinrich makes a very pleasing impression, which is especially due to her slender form and fine lines. The appearance of the vessel is much enhanced by the comparatively slender masts with one fighting top each and the two high smokestacks, the cross section of one of which is circular, while that of the other is oval.

Two river gunboats constructed at Hamburg, have been tried. They made a speed of 11½ knots per hour. They will be sent to Africa for river work.

No. 107.—The torpedo-boat destroyer No. 107 had her trials early in April. The contract required a speed of 27 knots. The speed made was 28.4 knots per hour. This destroyer was built at the Schichau works.

G 108.—The torpedo-boat destroyer G 108 was given her speed trials on the 23d of March. The speed attained was 28.6 knots per hour.

The German government has ordered the construction of the 11,000-ton, 19-knot speed battleships Wittelsbach, Wettin, and Zähringen be pushed with great rapidity so that their trials may occur in March, 1903. The battleship Mecklenburg and Schwaben, of the same type, are to be ready for trial in November, 1903.

GREAT BRITAIN.

VESSELS BUILDING.

Name.	Displacement, tons.	Where Building.	Remarks, date of launch, completion, etc.
Battleships.			
Commonwealth	16,500	Jarrow.	Ordered.
Dominion	16,500	London.	"
King Edward VII	16,500	Devonport.	Begun.
Queen	15,000	"	Launched March 8, 1902.
Prince of Wales	15,000	Chatham.	Lchd. March 25; compl. 1903.
Albemarle	14,000	"	" March 5, '01; compl. '03.
Cornwallis	14,000	Blackwall.	" July 17, '01; compl. '03.
Duncan	14,000	"	" Mar. 21, '01; compl. '03.
Exmouth	14,000	Birkenhead.	" Aug. 31, '01; compl. '03.
Montagu	14,000	Devonport.	" March 5, '01; compl. '03.
Russell	14,000	Jarrow.	" Feb. 19, '01; compl. '03.
Bulwark	15,000	Devonport.	Launched; completed.
Venerable	15,000	Chatham.	" compl. this year.
London	15,000	Portsmouth.	Launched; under trial, nearly completed.
Armored Cruisers.			
Drake	14,100	Pembroke.	Lchd. Mar. 5, '01; compl. '03.
King Alfred	14,100	Barrow.	" Oct. 28, '01; compl. '03.
Leviathan	14,100	Clydebank.	" July 23, '01; compl. '03.
Good Hope	14,100	Portsmouth.	" Feb. 21, '01; completed.
Hampshire	10,200	.....	Ordered.
Devonshire	10,200	Chatham.	Building.
Roxburgh	10,200	....	Ordered.
Antrim	10,200	.....	"
Argyll	10,200	.....	"
Carnarvon	10,200	.....	"

VESSELS BUILDING—*Continued.*

Name.	Displacement, tons.	Where Building.	Remarks, date of launch, completion, etc.
Essex	9,800	Pembroke.	Lchd. Aug. 24, '01; compl. '02.
Kent	9,800	Portsmouth.	" Mar. 6, '01; " '02.
Monmouth	9,800	Glasgow.	" Nov. 13, '01; " '03.
Bedford	9,800	Govan.	" Aug. 31, '01; " '02.
Cornwall	9,800	Pembroke.	Building.
Suffolk	9,800	Portsmouth.	"
Berwick	9,800	Glasgow.	"
Cumberland	9,800	Glasgow.	.....
Lancaster	9,800	Elswick.	Launched Mar. 22; compl. '03.
Donegal	9,800	Govan.	.....
Hogue	12,000	Barrow.	Trials finished; practically completed.
Sutlej	12.000	Chatham.	Trials finished; practically completed.
Buryalus	12,000	Barrow.	Completed in 1903.
Bacchante	12,000	Chatham.	Trials finished; practically completed.
Protected Cruisers.			
Spartiate	11,000	Portsmouth.	Completed.
Challenger	5,880	Chatham.	.....
Encounter	5,880	Devonport.	.....
Turquoise	3,000	Glasgow.	Ordered.
Amethyst	3,000	"	"
Gunboats.			
Odin	1,096	Sheerness.	Practically complete.
Merlin	1,096	"	" "
Espiegle	1,075	"	" "
Fantome	1,075	"	" "
Cadmus	1,096	"	Ordered.
Clio	1,096	"	"
Torpedo Boat Destroyers.			
Derwent	...	.....	.....
Eden	....	.....	.....
Erne	....	.....	.....
Exe	....	.....	.....
Ettrick	....	.....	.....
Foyle	....	.....	.....
Ribben	....	.....	.....
Ribble	....	.....	.....
Teviot	....	.....	.....
Usk	....	.....	.....
Arab	320	Clydebank.	Trials finished; complete.
Ostrich	355	Govan.	" " "
Express	430	Birkenhead.	" " "
Success	350	Sunderland.	" " "
Torpedo Boats.			
1	185	Cheswick.	Ordered.
2	185	"	"
3	185	"	"
4	185	"	"
Submarine Boats.			
1	120	Barrow.	Nearly complete.
2	120	"	" "
3	120	"	" "
4	120	"	" "
5	120	"	" "
6	?	"	Ordered.

NEW WARSHIPS BUILT AND BUILDING.—Between April 1, 1901, and March 31, 1902, inclusive, the following ships have been completed and have passed into the Fleet Reserve:—Battleships: Formidable, Implacable, Irresistible, Bulwark, Vengeance. Armored cruisers: Aboukir, Cressy, Hogue, Sutlej. First-class cruiser (protected): Spartiate. Third-class cruiser (protected): Pandora. Royal yacht: Victoria and Albert. Sloops: Mutine, Rinaldo, Espiègle, Fantome. River steamers: Teal and Moorhen. Twenty-two destroyers, four torpedo boats, five submarines. On April 1, 1902, there will be under construction thirteen battleships, twenty-two armored cruisers, two second-class cruisers, two third-class cruisers, four sloops, two auxiliary vessels, ten destroyers, and five torpedo boats; and it is expected that between April 1, 1902, and March 31, 1903, inclusive, the following ships will have been completed and passed into the Fleet Reserve: five battleships, seven armored cruisers, two sloops, two auxiliary vessels, and two destroyers. It is proposed to commence during the financial year 1902-3 two battleships, 2 armored cruisers, two third-class cruisers, four scouts, nine destroyers, four torpedo boats, and four submarines. The following plan of reconstruction has been decided upon, and great progress will be made with it during the ensuing year. Battleships—Royal Sovereign class: The 6-in. guns on the upper deck will all be put into casemates. Barfleur and Centurion: All the 4.7 guns will be taken out and replaced by 6-inch guns in casemates. Cruisers—Powerful and Terrible: Four 6-inch guns in casemates will be added to the armament of each of these cruisers. Arrogant and Talbot classes, comprising thirteen ships: All the 4.7-inch guns will be taken out and replaced with 6-inch guns.

COMPARATIVE STRENGTH IN SHIPS.—In the new issue of the *Naval Annual*, the editor, the Hon. T. A. Brassey, writes on "Comparative Strength," and points out that in this respect considerable modifications have recently taken place. Ten years ago the only navy which could bear any comparison with our own was that of France. Next to France came Russia, and then Italy. Germany and the United States were almost negligible quantities, while the Japanese had scarcely begun to construct a fighting fleet. But much has happened since then. France and Italy have dropped back relatively to other powers. Russia, Germany, and the United States have all improved their position, and when the vessels now building for them are completed they will each possess a larger number of first-class battleships than France. On the other hand, it must be remembered that the French have been concentrating their efforts on the building of armored cruisers, of which they have thirteen under construction, as compared with three for Germany and nine for the United States, while the new cruisers building for Russia can hardly be considered of the first-class. Japan has in the interval come rapidly to the front as a naval force. The following tables show how all the powers stand as regards battleships and cruisers, built and building:

BATTLESHIPS.

	First Class.	Second Class.	Third Class.	Total.
Great Britain	41	11	17	69
France	13	10	15	38
Russia	15	10	8	33
Italy	9	5	2	16
Germany	16	—	15	31
United States	17	—	11	28
Japan	6	—	2	8

CRUISERS.

	First Class.	Second Class.	Third Class.	Total.
Great Britain	49	62	46	157
France	19	23	13	55
Russia	16	7	8	31
Italy	5	5	11	21
Germany	6	8	20	34
United States	13	10	11	34
Japan	6	10	8	24

The first question suggested by these figures is one with which we are all familiar. Do they show that Great Britain is still well up to the two-power standard laid down so many years ago by Lord George Hamilton and maintained by successive First Lords of the Admiralty? To a large extent the answer must be in the affirmative. We have 29 first-class battleships completed to 17 for France and Russia. We have 41 first-class battleships built and building, as against 13 for France and 15 for Russia, or together 28. If we add the 16 first-class battleships built and building for Germany, then, in view of the recent alliance, the six Japanese battleships might be added to our own. That would leave 47 first-class battleships for Britain and Japan, as compared with 44 for Russia, France, and Germany. Of second-class battleships we have 11, as against 20 for France and Russia. Of third-class battleships (which are of no importance in estimating strength) we have 17, while France and Russia have 23. Coming to cruisers we have 49 of the first-class built and building, as compared with 19 for France and 16 for Russia—together, 35. Even if the six of Germany are thrown into the scale we still have a preponderating number of eight. It is only if we look upon the United States as a possible enemy that our naval position assumes an unfavorable aspect; otherwise it is of a fairly gratifying kind. This fact also must be taken into account that the new British battleships under construction have a displacement of 16,350 tons, and that in all other respects they will be the most powerful fighting machines of the world.—*United Service Gazette*, May 10, 1902.

THE MANNING OF THE NAVY.—The numbers of men voted for the navy for the current year were 118,625 active service ratings. It is expected that the establishment will have been reached by the end of the financial year, as recruiting has been good. The numbers proposed for next year are 122,500. The increases will consist of the following ranks and ratings: Officers, 266; warrant officers, 143; seamen, 1500; artisans and electricians, 250; engine-room artificers, 150; stokers, 1000; miscellaneous, 400; boys—shipwrights and coopers—166; total, 3875.

THE BRITISH NAVAL PROGRAM FOR 1903—REORGANIZING THE NAVY.—According to the naval program of the British government for 1902 many important changes are advocated in the construction and armament of future battleships. This decision is the result of the recent progressive developments in explosives and projectiles. The vote for the navy for the present year aggregates $156,275,000, which is an increase of $897,500 over the estimates for the year 1901. Of this total sum $45,290,000 is to be expended upon the construction of 27 new warships

of all types, comprising two battleships, two armored cruisers, two third-class cruisers, four "scouts," nine destroyers, four torpedo boats, four submarines.

Although the sum voted for new vessels is smaller than was anticipated, the Admiralty, following the example of France and certain other European powers, intend to devote a large sum of money to extensive rearmament and overhauling of the largest and comparatively recent vessels of the present navy. This scheme of modernization affects 25 vessels in all. The plan of reconstruction is as follows:

Eight battleships of the Royal Sovereign class to have secondary batteries on upper deck (comprising six 6-inch quick-firers each) placed in armored casemates.

Battleships Barfleur and Centurion, each to have her ten 4.7-inch guns firing a 50-pound shell replaced by 6-inch quick-firers firing a 100-pound shell.

Cruisers Powerful and Terrible, each to have four more 6-inch quick-firers in casemates added, increasing the total number of these weapons to 16.

Thirteen cruisers of the Arrogant and Talbot classes, each to have six 6-inch quick-firers in place of 4.7-inch weapons.

During 1902 the construction of 60 new vessels will be completed and 27 new vessels commenced, and by March 31, 1903, the navy will be augmented by the following strength: Battleships, 13; cruisers, armored, 22; cruisers, second-class, 2; cruisers, third-class, 2; sloops, 4; auxiliary vessels, 2; destroyers, 10; torpedo boats, 5; battleships authorized in 1902 program, 27; total, 85 vessels of all types.

The decision of the Inquiry Committee into the recent mysterious loss of the torpedo-boat destroyer Cobra in the North Sea, due to frailty in construction, and also the numerous accidents, such as buckling and starting of plates, that have befallen other destroyers when encountering heavy weather, has not proved unavailing with the Naval Department. The designs for this type of vessel and the work it is to accomplish have been considerably modified. When destroyers were first designed it was not contemplated that they would be frequently used otherwise than as working from a fixed base. Experience, however, has shown that vessels with greater sea-keeping power are required for service with the fleets, and, accordingly, the Admiralty has decided both materially to strengthen the type of future destroyers and also to create a new class altogether, to which the name "scout" has been given. The Admiralty do not propose that the naval designer should initiate a design for this new class of vessel, but invite the private shipbuilders of the country to give the navy the benefit of their creative ingenuity by submitting designs to fulfill certain stated conditions.

Moreover, a special committee has also been appointed to advise the Admiralty in respect of the strengthening of some of the existing vessels. The Naval Department has often been urged to build large numbers of destroyers at a time; but this is not considered an advisable policy. In the first place, the destroyer is a type of warship which is still in process of rapid evolution; in the second place, it must by its nature be a short-lived type; and to build large numbers in the same year would inevitably result in large numbers becoming obsolete at the same time.

A new departure is also to be made in connection with the disposition

of the armor, in the armor-clads, as an offset to the vast improvements that have recently been made in high power explosives and shells. This arrangement of the armor is to be made upon the three new first-class battleships, which will be named, respectively, King Edward VII, Commonwealth and Dominion. When completed these vessels will be far ahead of any of the battleships in the British navy, so far as the armor protection and its scheme of disposition is concerned. Indeed, the only vessel to compare with them is the Japanese battleship Mikasa, built by the Vickers-Maxim Company, whose design is stated to be the result of this innovation in the British practice of armor protection. As in the Mikasa, the main broadside armor of the new British ships is to be carried to the upper deck, so that all broadside guns on the main deck will be completely protected by the armor of the citadel. The new British ships will excel the Japanese Mikasa in the thickness of plating, owing to their larger total displacement, for while the Mikasa is 15,200 tons, these new vessels are to be of 16,350 tons. This main belt will, as in the Mikasa, be between 21 feet and 22 feet deep, extending 5 feet below the water-line, so that in the event of the ship's rolling there will be no chance of the unarmored bottom being exposed, even momentarily, to hostile fire. Over 70 per cent of the total length of the new ships will be protected by belts, whereas in the Majestic class the proportion of the length armored is 55 per cent, in the Admiral class 43 per cent, and in the Inflexible 34 per cent. The water-line belts in the new ships will be 9 inches thick in the citadel, reduced by stages to 4 inches at the ends. For the length of the citadel the thickness will be 8 inches from the main belt up to the level of the main deck, and from the main deck to the upper deck 7 inches. The division bulkheads between the 6-inch guns on the main deck and the longitudinal armor wall behind the guns will be of hardened steel.

The new armored cruisers are to be of a modified County type. They will be 450 feet in length, 67 feet beam, and 10,200 tons displacement, whereas the County class measure 440 feet in length by 66 feet beam with a displacement of 9800 tons. The new vessels, however, will have the same draught of 24 feet 6 inches. The slight increase in length is to enable a different type of boiler to be used, and also to allow of 7.5-inch guns to be used in each turret at the forward and after end of the vessels, instead of twin 6-inch guns as in some of the preceding ships.

Another new departure is to be the inauguration of coal depot vessels for torpedo-boat destroyers, of two distinct characters, to be utilized accordingly as the destroyers are, or are not acting from a fixed base. One class of depot ship is being prepared for the flotillas at the home ports, and the Leander is being prepared as a depot ship for the destroyers in the Mediterranean. From this experience the Naval Department hope to learn more clearly what is exactly required in this direction; but if the new "scout" class should prove a success, these depot ships would not be wanted for them to the same extent. In the case of distilling ships, one has been bought and fitted which should be in service within the year, and experiments have been made with others. But in this connection it is suggested that far more satisfaction would be attained if by improvements in the boilers ships were to distill their own water, and to be rendered independent of auxiliary distilling vessels.

In connection with fuel, the Admiralty are continuing their experi-

ments with the Temperley-Miller apparatus for coaling battleships while in motion, and are also studying the possibility of utilizing oil fuel. An engineer has been specially detailed to superintend the latter experiments, so that the trials may be conducted thoroughly, and exhaustive information obtained as to the feasibility of employing liquid fuel upon a sufficiently extensive scale. Reserve stocks of patent fuel have been deposited at the several naval depots abroad also.

Although the unfortunate disasters to the Viper and Cobra prevented the Admiralty from obtaining sufficient data regarding the possibilities of utilizing the Parsons turbine for the propulsion of war vessels, the Naval Department intend to experiment further with these turbines. For this purpose two torpedo-boat destroyers and one third-class cruiser are to be engined with the Parsons turbine. The fitting of the turbine in the latter vessel will afford a splendid opportunity for effectively testing its qualities as compared with reciprocating engines, for in this case, in view of the high speed to be developed, the weight available for the machinery has to be minimized. The speed for 3000 tons displacement on a draught of 14 feet 6 inches is to be 21¾ knots, and yet only 548 tons is allowed for machinery; so that even with water-tube boilers of the express type only 2.65 square feet of heating surface is allowed per horsepower, and the boilers are required to develop 20 horsepower per square foot of heating surface.

An important alteration has also been made with regard to the letting out of contracts and the supervision of naval construction in private yards. Hitherto this duty has been performed by the Department of Naval Construction. It is now considered, however, owing to the magnitude of the fleet, that this department is sufficiently occupied with the duty of designing. This responsibility of supervising private naval work is to be vested in a new department, the chief of which is to be officially known as the Controller of the Navy. The qualifications of this official are a thorough knowledge of Admiralty practice and an exhaustive technical knowledge of ship construction. It is anticipated that naval construction in private yards will, as a result of this change in the Admiralty administration, considerably facilitate and expedite the execution of Admiralty contracts, which will result in a greater efficiency and economy. —*Scientific American*, March 15, 1902.

Early last month the king laid the foundation stone of the new college for naval cadets which is to take the place of the famous old *Britannia*, within whose wooden walls nearly all of our naval officers have been educated. In some quarters it is thought that the building of the college may mark something of a fresh departure in the system of training officers for the sea, this remains to be seen.—*The Marine Engineer*, April 1, 1902.

The 6-inch guns on the upper decks of all the ships of the Royal Sovereign class will be put into casemates. The 4.7-inch guns will be taken out of the Barfleur and the Centurion and replaced by 6-inch guns in casemates. Four 6-inch guns in casemates will be added to the armament of the Powerful and the Terrible, and in all the thirteen ships of the Arrogant and Talbot classes the 4.7-inch guns will be replaced by 6-inch guns.

The programme of new construction comprises two battleships, two armored cruisers, two third-class cruisers, four scouts, nine destroyers, four torpedo boats, and four submarines.

A very interesting statistical table is that of the results of the Annual Prize Firing Competition on the China station. Of the 28 ships entered for the Seymour challenge shield, we reproduce those of the first four only here:

Ship.	Gun.	Rounds.	Hits.	Hits per gun per minute.	Percentage of hits.
Terrible	9.2-in.	22	14	1.16	63.6
Terrible	6 -in.	128	102	4.25	80
Barfleur	10 -in.	47	23	.9	49
Barfleur	4.7-in.	159	114	5.7	71.7
Ocean	12 -in.	26	15	.6	57.9
Astraca	6 -in.	21	14	3.5	66.6
Astraca	4.7-in.	136	48	3	35.3

This, roughly speaking, gives us the following results for the respective guns:

A 12-inch gun can make .6 hits per minute; a 10-inch gun .9; a 9.2-inch gun 1.16; a 6-inch gun 4.25; and a 4.7-inch gun 5.7. This is not perhaps ideal shooting, but it is decidedly better than the practice made by either the Channel or the Mediterranean squadrons. The only information to hand of the latter squadron is of a fragmentary and not entirely assuring character. Of the Channel squadron, the Mars is on paper the best vessel with a percentage of .4 hits per gun per minute with 12-inch guns, and 2.6 with 6-inch Q. F. This is far behind the record of Petty Officer Grounds, of the Terrible, who made eight hits in eight rounds in one minute, which is to say, that if all the guns were handled equally skilfully, the twelve guns could have made 192 hits in a two-minutes' run.—*Army and Navy Gazette*, March 22, 1902.

The following ships, which, it was originally intended should be fitted with Belleville boilers, are, in place of these, to be fitted with Babcock and Wilcox boilers: Queen, Cornwall, Challenger, Hermes. The three vessels of the King Edward VII class are to be fitted with a combination of two-fifths cylindrical and three-fifths Babcock and Wilcox boilers.

To illustrate the rapidity with which shipbuilding is carried on in government yards in Great Britain, attention is drawn to the recent launching of the Queen at Devonport. As the Queen left the launching ways, the first keel plate of the King Edward VII was lowered in the place just vacated by the Queen.

The editor of the PROCEEDINGS has received from Messrs Yarrow and Co., the following two letters, the first enclosing an extract from the *London Times:*

TO THE EDITOR OF THE TIMES:—Sir.—May I be permitted to endeavour to remove the want of confidence which is felt just now, due to recent events, by naval officers and the public, touching the seaworthiness of vessels of the torpedo boat type (which includes destroyers)?

The following is a short statement of the number of vessels of this

class, varying from 100 feet to 220 feet in length, which we have constructed, and which have navigated long distances without showing the slightest symptom of structural weakness:—Thirteen navigated to Buenos Ayres; 11 to Pola; four to Rio de Janeiro; two to Valparaiso; one to China; five to Holland; two to the Dutch East Indies; one to Ecuador (via Cape Horn); six to Greece; five to Italy; six to Japan; one to the Black Sea; one to St. Petersburg; and one to Australia. Total 59.

I may add that we make a practice of insuring our vessels until they are handed over, which sometimes includes delivery at distant ports, and we have never had occasion to make a claim on the underwriters either due to structural weakness or breakdown of machinery.

I remain, Sir, yours truly,

A. F. YARROW.

Isle of Dogs, Poplar, E., Oct. 21.

To the Editor of U. S. Naval Institute Proceedings.

Isle of Dogs, Poplar, London, E., Feb. 24, 1902.

Sir.—Owing to the distrust that appears to exist with regard to the structural strength of torpedo-boat destroyers and the reliability of the machinery, which is often evinced by the difficulty in obtaining the contract speed, we thought the enclosed particulars might be of interest to your readers.

In the first place we enclose you a copy of a letter Mr. Yarrow recently wrote to the London *Times*, which bears very conclusively on the subject of structural strength.

We may mention that we have built eight torpedo-boat destroyers, 220 feet long, having a speed of over thirty-one knots. Six of these have steamed out to Japan, and during the Eastern crisis have been in constant service between Japan and China, and have not shown any symptoms of structural weakness, which further indicates the practicability of building destroyers of ample strength but at the same time retaining the high rate of speed.

As regards the difficulty in obtaining the contract speed in these vessels, we beg to annex a list of the eight destroyers with the dates when they were launched and the dates when the official trials were made. The short interval between the date of launching and the date of official trial is conclusive evidence that little or no trouble was experienced in the working of the machinery, and the air-pressure required to obtain the speed of over 31 knots varied from one inch to two-and-a-quarter inches, indicating that the boilers, to obtain this speed, were in no way forced.

The consumption of fuel per H. P. varied from two to two-and-a-quarter lbs. of coal per H. P. per hour.

It will be regrettable if, owing to the failure of certain boats in structural strength, designers overload the vessels by unnecessary material.

We would point out that certain vessels failing in structural strength only indicates that those vessels were deficient in that respect: it does not indicate that vessels of the same scantlings, differently put together, might not be of ample strength; and it must be admitted that the above facts point conclusively that, with a proper distribution of material and first-class workmanship, there is no difficulty in getting the highest speeds with vessels of ample strength, and at the same time with reliable and economical machinery.

There is one point that seems not to be sufficiently appreciated and that is that the safety of lightly-constructed vessels, such as destroyers, is dependent to a very large extent upon its elasticity when encountering rough weather, and this elasticity must be as uniform throughout the structure as it is possible to make it, otherwise the bending which takes place will be concentrated at certain parts, and the metal at those parts, after a certain time, gets fatigued and ultimately gives way. To study how to secure uniformity of elasticity throughout the structure in vessels of the destroyer class we are sure deserves more attention on the part of constructors than has hitherto been devoted to it.

We remain, Sir, yours truly,

For YARROW & Co., LTD.
E. J. Y.

TORPEDO-BOAT DESTROYERS FOR THE IMPERIAL JAPANESE NAVY BUILT BY MESSRS. YARROW & Co., LTD., POPLAR.

Name.	Date of launch.	Date of official trial.	Speed in knots.
Ikadsuchi.....	Nov. 15, 1898	Dec. 23, 1898	31.32
Inadsuma.....	Jan. 28, 1899	March 8, 1899	31.037
Akebono.....	April 25, 1897	May 4, 1899	31.08
Sazanami.....	July 8, 1899	July 20, 1899	31.382
Oboro.....	Oct. 5, 1899	Oct. 14, 1899	31.262
Niji.....	Dec. 16, 1899	Dec. 21, 1899	31.156
Akatsuki.....	Nov. 13, 1901	Nov. 21, 1901	31.121
Kasumi.....	Jan. 23, 1902	Jan. 29, 1902	31.245

The trial in each case consisted of a continuous run of three hours' duration, carrying a load of 35 tons in the case of the first six and 40 tons in the case of the last two destroyers.

Isle of Dogs, Poplar, London, E., May 24, 1902.

Dear Sir.—We beg to annex a short paragraph which we thought you would consider of sufficient public interest for insertion in your next issue.

We remain, dear Sir, yours truly,

For YARROW & Co., LTD.,
H. B.

A very fast yacht, built to the order of Colonel McCalmont from designs prepared by Messrs. Cox & King, was launched on Saturday the 24th inst. from the yard of Messrs. Yarrow & Co., Poplar. This yacht is of very special design, being built on the lines customary with vessels of the torpedo-boat class and provided with turbine engines constructed by Messrs. Parsons, fitted with three shafts and three propellers—on each shaft. As regards the hull and boilers, the yacht is identically similar to a first-class torpedo boat, the boilers being of the Yarrow type; therefore the trials will be watched with interest, as forming a fair comparison with those of similar vessels provided with boilers of this class but fitted with reciprocating engines, the machinery being the only portion of the vessel in which it differs from a Yarrow first-class torpedo boat.

FLOATING DOCK FOR BERMUDA.—The great floating dock which was launched from the yard of the builders, Messrs. C. S. Swan & Hunter,

Ltd., of Wallsend-on-Tyne, on Saturday, the 8th of February, has been built to the order of the Lords Commissioners of the Admiralty, and is to be placed in His Majesty's dockyard at Bermuda, where it will replace the old floating dock that has been there since 1869, and which has now become obsolete, not through age but through the insufficiency of its dimensions. It is interesting to make a comparison between the dimensions of the old and the present docks, for they show very clearly the great increase that there has been in the size of the ships of our fleet since the old dock was built, for it, like the present one, was designed with a view to accommodating the largest vessels that were then built or building. The length of the old dock was 381 feet over all, but to obtain its maximum lifting power, gates were fitted which reduced its practical length to 330 feet. Its inside width was 84 feet between side-walls, and its lifting power was 8000 tons, which was sufficient for the ships of the Bellerophon class, to lift which it was specially designed, although it was capable of bringing the keel out of the water of vessels up to 10,200 tons, the then heaviest ships represented by the long fully-rigged line-of-battleships Agincourt and Minotaur. The present dock is 545 feet long, and having no gates, the length of ship it can take is not restricted; its clear width of entrance between rubbing fenders is 100 feet. Its lifting power up to the pontoon deck level is 15,500 tons, but by utilizing the shallow pound this can be increased to 17,500 tons, and the walls are of sufficient height to allow of a vessel drawing 32 feet to be taken on 3.6-feet keel blocks.

The present dock is of the type known as a floating graving-dock, the invention of Messrs. Clark & Standfield, from whose plans it was built. This type, of which many examples already exist, notably the large 18,000-ton dock for the American navy, which has just successfully lifted the battleship Illinois, was specially introduced by that firm with a view of producing a structure having a large amount of longitudinal rigidity. The necessity for such rigidity will be apparent when the different types of vessel that the present dock will be called on to lift are remembered. Primarily, it has to lift the line-of-battleships of 15,000 tons displacement with a length of bearing keel of 343 feet, but in addition it has to deal with cruisers of the Terrible class, of about the same displacement but with 383 feet of bearing keel, and lastly, auxiliary cruisers like the Campania, weighing some 17,000 tons, with a bearing length of keel of 502 feet. It is evident, therefore, that great longitudinal strength is necessary, since whilst the dock has to be long enough to deal with the 600-foot Campania, practically the whole displacement of the 545 feet, long pontoons have to be utilized to lift a vessel bearing only on some 384 feet of their length. Apart from this, the fact that the dock in its voyage out to Bermuda may have to encounter the long rollers of the Atlantic, also makes it imperative that a very stiff form of structure should be employed.

Like the original Bermuda dock, the present one is a self-docking dock, that is it can lift all parts of itself out of water, a most necessary facility in the sub-tropical sea of Bermuda. The dock itself consists of five portions, comprising three pontoons which form the main lifting portion of the dock, and two side walls, which, whilst affording a certain amount of lifting power, primarily serve to give the dock stability, and to regulate its descent when the pontoons are submerged. The center pontoon, which is 300 feet long, is rectangular in shape, but the two

terminal pontoons 120 feet long, have each only 71 feet of that length rectangular in shape, the remainder being finished off in the form of a blunt-nosed point or bow. The sides of the rectangular portion of all the pontoons are built up so as to form a broad altar standing 12 feet above the deck.

The side walls which come to each side of the pontoons, to which they are attached by double fish plates and tapered pins, taking on to the steel lugs built into the structure both of the wall and pontoon (thus enabling any of the pontoons to be disconnected for the purpose of self-docking) are rectangular structures 435 feet long by 53.3 feet, etc., high. From their base up to the altar level their width is 13.2 feet, but from here they batter back to the engine deck where their width is 9.1 feet. Where the boilers occur, however, this engine deck is built out at the back to form a chamber 12.6 feet wide. The walls are pierced with two gangway openings admitting light and air into the interior, and the upper portions or towers are cut down at each end, leaving a flat on which the bollards are placed and the swing bridges, which give access from the top of one wall to that of the other. The ends of the side walls are bevelled off from the back to the same line as that of the pointed portion of the pontoons, thus forming a continuous bow line for the purposes of facilitating the towing.

The pontoons of the dock are divided into 40 pumping divisions, of which 32 are absolutely water-tight and distinct. The side walls have each eight water-tight divisions. All these 56 divisions are provided with a separate pipe, each governed by a separate valve. All the pipes in the starboard half of the dock are led directly into the main drain in the starboard wall, and those on the port side into the port wall. These drains are continuous over the whole length of the walls, and the four 18-inch centrifugal pumps in each wall are seated directly on them, so that any one pump can empty all the compartments of its half of dock. Furthermore, the central bulkhead dividing the dock into the two halves is not entirely water-tight, but small drainage or leakage holes are left in it, so that even in the event of a complete break-down of the whole of the plant, the other half could still slowly empty the whole dock.

A separate condensing compound engine driving directly on the pump shaft is provided for each pump, and a separate return-tube marine boiler for each pair of engines. The steam pipes are, however, so arranged that either engine can take its steam from either boilers. Each boiler, engine, and pump is, therefore, duplicated in each wall, and further, each wall duplicates the other, so that if only the boiler, engine, and pump remain available the dock can still be lifted.

Special provision has been made on the broad altars for the support of the armor belt of battleships, a stiff channel running along on top of them into which the heel of the vertical shores can be stepped, whilst similar channels along the face of the altars receive the raking shores that support the bilges, the shape of the dock at this part resembling fairly closely the stone steps or altars of an ordinary masonry dock.

The dock is provided with the usual fittings in the way of strong bollards on the low walls and timber-heads on the top deck, and for warping the vessel into place, six powerful vertical steam capstans are provided with sheaves or fairleads on the edge of the top deck. An electric-light installation with its own generating plant is provided in one wall for lighting all the interior compartments of the dock, and in

addition twelve arc lamps are carried on gallows on top of the towers, which light up when required the whole dock and ship, whilst further mains are led along the dock's sides, from which hand-lamps may be taken off to light up any particular spot where special work is being carried on.

A very useful fitting for handling weights either on the dock or ship will be found in the travelling and swinging electric cranes which run along the whole length of each wall. They are of five tons lifting power with a jib radius of 30 feet, and a lift of 35 feet above the top deck. They are electrically driven by means of a separate generating plant placed in the towers, but this plant is so arranged with the electric-lighting plant that they can be used alternately or together for either lighting or working the cranes. These auxiliary installations, whilst usually taking their steam from the dock's boilers, they are each provided with their own boilers, making them independent therefore of the main pumping installation.

A complete drainage service communicating with all the dock compartments, and capable of emptying them completely, is installed in each wall, and by the alteration of a coupling, this service can also be used as a washing-down service, by means of which the outside of the ships on the dock can be washed down, or their inside tanks tested with water.

The bottom of the pontoon is protected by a series of bilge-keels of greenheart, as it is possible that at low water the dock may to a certain extent sit upon the rough coral bottom of the harbor where she will be moored. The top decks of the walls are planked with teak with a waterway all round, and arrangements are made in view of the scarcity of fresh water at Bermuda for catching and running into the reserve water tanks inside the walls all rain water falling on these docks.

The pumping machinery of the dock has been provided and erected by the Wallsend Slipway and Engineering Company, Ltd., the engines and pumps being by Messrs. Allen & Co., of Bedford. The electric-lighting installation, the electric travelling cranes, and the generating plant for the same are made by Messrs. Clark, Chapman & Co., Ltd., who also fitted the steam capstans on the top decks. The dock will remain on the Tyne until the fittings are completed, and in the early spring she will be towed to Chatham, where her trials will take place, consisting in the lifting of a first-class line-of-battleship, and the self-docking of her pontoons. After this she will start on her long voyage to Bermuda.—*The Steamship*, March, 1902.

TRAINING.—The necessity of special training in the care and management of water-tube boilers has made itself felt. An old battleship is to be used at Devonport for this kind of training. It is to be fitted with boilers of the following types: Yarrow, Dürr, Babcock and Wilcox, Belleville, and Niclausse boilers.

Notice has been given by the British Admiralty that all hope that the war sloop Condor may still be afloat has been abandoned.

PERSONNEL.—The Admiralty have decided upon a course which will greatly add to our list of officers on the reserve for service in the case of emergency; this consists in recommissioning officers as volunteers

upon the expiry of their service, owing to age or other causes. Such officers recommissioned will, as a rule, require to serve for three weeks or so at stated periods, every two years as a rule, at some ordnance or torpedo school, so as to keep them in touch with modern developments. As lieutenants have to retire from the service at a certain age in large numbers, owing to the slowness of promotion to the rank of commander, the number of ex-officers available for such volunteer service is very great, and already a large number have had their commissions restored, and have been placed on the list of volunteers for duty in the event of war or emergency. The same scheme will also ensure the services in the hour of danger of several officers, who have left the navy to take up important positions with private firms, and these are especially valuable accessories owing to their commercial and industrial experience and their knowledge of modern ordnance in this and other countries.—*United Service Gazette*, April 12, 1902.

New Contracts.—The details of the distribution of the new Admiralty contract work show that the Clyde has secured a very large share. Of the two battleships of King Edward class the Fairfield Company, Govan, are to build one, and Messrs. Vickers, Sons, and Maxim, Barrow-in-Furness, the other. Of the five first-class cruisers, four are to be built on the Clyde—one by the London and Glasgow Company, Govan; one by Messrs. Wm. Beardmore and Co., Govan; one by Messrs. John Brown and Co., Clydebank; and the fourth by Messrs. Scott and Co., Greenock. The fifth vessel is to be built at the Elswick works of Sir W. G. Armstrong, Whitworth, and Co. (Limited). As to the third-class cruisers, one is to be constructed by Messrs. Laird, of Birkenhead, and the other at Elswick. The latter vessel is to be fitted with Parson's steam turbines, with a small set of triple-expansion reciprocating engines for driving two of the propeller shafts at low speed. Ten destroyers were included in the year's programme, and these also have been ordered. Three are to be built by Messrs. Laird, of Birkenhead; three by Messrs. Yarrow, of London; two by Messrs. Palmer, Jarrow-on-Tyne; and two by Messrs. Hawthorn, Leslie and Co., Newcastle-on-Tyne. One of the latter is to be driven by turbine machinery.—*United Service Gazette*, April 5, 1902.

The following tables are from *Engineering* of March 7, 1902:

H. M. S. Good Hope, Progressive Speed Trials.

Table I.—Stokehold Temperatures on Full-Power Trial.

Hours.	Deck Temperature.	Aft.				Forward.			
		Stokehold. 1.	First Double Fan-Flat. 2.	Stokehold. 3.	Second Double Fan-Flat. 4.	Stokehold. 5.	Third Double Fan-Flat. 6.	Stokehold. 7.	Fourth Double Fan-Flat. 8.
	deg.	deg.	deg.	deg.	deg.	deg.	deg.	deg.	deg.
1	53	162	120	110	124	104	126	108	122
2	53	101	120	108	126	102	124	107	123
3	52	104	134	104	130	106	132	112	128
4	52	107	141	98	146	107	140	119	132
5	52	105	142	100	146	104	140	120	131
6	52	99	145	102	144	101	139	122	132
7	51	92	146	103	145	99	139	123	132
8	50	94	145	102	145	98	139	122	134

TABLE II.—H. M. S. GOOD HOPE.—PROGRESSIVE SPEED TRIALS.

	Four Runs at 10 Knots in Stokes Bay, Feb. 27, 1902.		Four Runs at 13 Knots in Stokes Bay, Feb. 27, 1902.		Four Runs at 15 Knots in Stokes Bay, Feb. 27, 1902.		Three Runs at 18 Knots on Deep-Sea Course, Feb. 26, 1902.		Three Runs at 20 Knots on Deep-Sea Course, Feb. 26, 1902.		Four Runs at 22 Knots on Deep-Sea Course, Feb. 21, 1902.		Five Runs at 23 Knots on Deep-Sea Course, Feb. 24, 1902.	
Steam in boilers.....lb..	251		250		209		250		250		268		278	
	Star.	Port.	Star.	Port.	Star.	Port.	Star.	Port.	Star.	Port.	Star.	Port.	Star.	Port.
Vacuum.....in..	23	23¼	25	26	25	25¾	25½	26¼	26.0	26.4	26¼	27¼	26¼	27
Revolutions per minute... ..... No..	50.9	51.0	66.02	65.4	77.4	77.5	90.0	90.0	99.8	99.8	109.75	108.9	125.1	127.3
Mean pressure..... High .....lb..	15.95	15.3	25.02	24.65	34.7	33.25	50.0	45.0	66.0	62.8	94.1	95.2	107.1	104.3
Intermediate.....lb..	12.75	12.65	17.9	16.42	22.87	22.32	28.46	28.56	34.23	34.23	38.5	38.2	43.08	43.7
Forward low.....lb..	2.97	3.8	5.05	5.52	6.9	7.37	9.2	9.2	11.26	11.60	12.86	11.8	16.34	16.94
Aft low.....lb..	2.9	3.9	5.05	5.45	6.7	6.85	8.66	9.2	11.26	11.86	13.14	13.2	17.62	17.88
Mean air pressure.....in..	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	.2 in.	
Mean I. H. P... ..... High	293	281	596	561	966	923	1618	1458	2368	2254	3,702	3,727	4,823	4,779
Intermediate.....	623	620	1138	1031	1699	1652	2452	2464	3277	3277	4,035	3,993	5,173	5,340
Forward low.....	191	244	422	456	673	717	1044	1044	1416	1459	1,771	1,626	2,584	2,726
Aft low..... ..	186	251	422	450	656	666	984	1044	1416	1493	1,807	1,817	2,786	2,877
Mean total I. H. P.....	1283	1396	2578	2618	3996	3937	6098	6010	8477	8483	11,315	11,163	15,366	15,722
Mean collective I. H. P.....	2689		5096		7933		12,108		16,960		22,478		31,088	
Mean speed..... ....knots..	10.60		13.03		15.91		18.10		20.58		22.09		23.05	
Draught of water.....	F., 26ft. A., 26 ft.		F., 26 ft. A., 26 ft.		F., 26 ft. A., 26 ft.		F., 26 ft. A., 26 ft.		F., 26 ft. A., 26 ft.		F., 26 ft. 2 in. A., 26 ft. 2 in.		F., 26 ft. 1½ in. A., 26 ft. 1½ in.	

The designed draught was 26 ft., at which the displacement is 14,100 tons, so that on all the trials the vessel was at full load and on an even keel.

TABLE III.—MEAN RESULTS OF PROGRESSIVE SPEED TRIALS OF H. M. S. GOOD HOPE.

	Revolutions.	Indicated Horsepower.	Speed in Knots.	Slip, per Cent.
At 10 knots.....	51.0	2,689	10.6	7.2
" 13 "	65.8	5,096	13.63	7.5
" 15 "	77.5	7,953	15.91	8.4
" 18 "	90	12,108	18.10	10.2
" 20 "	99.8	16,960	20.58	8
" 22 "	109.1	22,467	22.10	9.6
" 23 "	126.2	31,088	23.05	18.5

Fig. 1. H.M.S. "GOOD HOPE"
I.H.P. & Slip at Various Speeds.

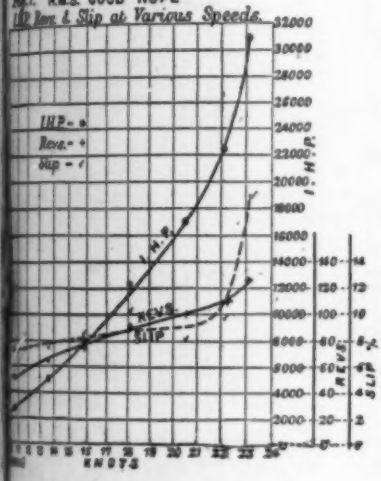


Fig. 2. H.M.S. "GOOD HOPE."
Coal Consumption & Distance Run in Miles per Hour at Various Speeds.

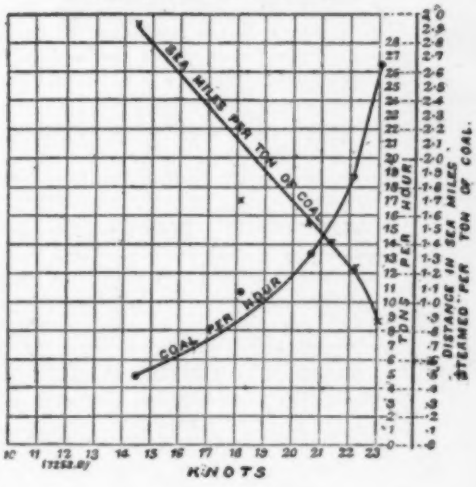


TABLE IV.—COAL AND WATER CONSUMPTION.

	Tons Fuel per Hour. Tons.	Distance Run per Ton Fuel. Knots.	Make-up Feed per 1,000 Indicated Horsepower per 24 Hours. Tons.
At 6,000 indicated horsepower (14.5 knots).....	4.94	2.93	3.43
At 12,000 indicated horsepower (18 knots).....	10.65	1.70	....
At 16,900 indicated horsepower (20¼ knots).....	13.26	1.55	....
At 22,467 indicated horsepower (22.10 knots).....	18.61	1.24	4.65
At 31,088 indicated horsepower (23.05 knots).....	26.5	.87	4.39

The designed draught was 30 ft., at which the displacement is 14,100 tons, so that on all the trials the vessel was at full load and on an even keel.

H. M. Cruiser Lancaster.—On Saturday, March 22d, the first-class cruiser Lancaster was launched at Elswick shipyard by Sir W. G. Armstrong, Whitworth and Co., Limited. The launch was a success in every way. The Lancaster forms one of ten sister vessels known as the Monmouth class. Of these, four—the Kent, Essex, Cornwall, and Suffolk—are dockyard built, the remainder being built by contract.

She was laid down on March 4, 1901, and therefore only slightly more than a year elapsed between her commencement and the launch. Her length is 440 feet, and her beam 66 feet, while her draught forward is 24 feet and aft 25 feet. Her displacement is 9800 tons, and her speed 23 knots. Her main armament consists of fourteen 6-inch guns. Two are carried in a twin-hooded barbette on the forecastle, and two similarly mounted are placed aft. The remainder are in casemates amidships—six on the main deck, and four on the upper deck. Thus six guns can fire ahead or astern, and nine on each broadside. There are besides ten 12-pounders, three 3-pounders, and eight Maxims distributed over the superstructure. Two submerged torpedo tubes are also fitted. This armament is protected in the main by 4-inch armor casemates, barbettes or hoods, while the bases of the gun positions, the water plane and the funnel uptakes, from the main deck down to five feet below the water-line, are protected by a belt of Armstrong armor varying from four inches to two inches in thickness. The usual curved protective deck, ¾ inch thick, protects machinery and magazines from shell splinters. The machinery, which is being constructed by Hawthorn, Leslie and Co., is to develop 22,000 indicated horsepower, and comprises two sets of four-cylinder triple-expansion engines, using steam at 250-lb. pressure. Steam is to be supplied by thirty-one Belleville boilers, which also provide steam for the various auxiliary machines, and there will be economizers. Four sets of dynamos are fitted with direct-acting compound engines for lighting, etc. These dynamos are of the multipolar type, supplying a direct current of 500 ampères, at 100 volts pressure. There are also steam steering engines, electric boat hoist, four distilling evaporators, air-compressing machinery, and ice-making machinery.—*The Engineer*, April 4, 1902.

The Steam Trials of H. M. S. Leviathan.—The first-class armored cruiser Leviathan, built by Messrs. John Brown and Co., Limited, Clydebank, for the British navy, completed last Monday afternoon her contract steam trials, with very satisfactory results, the full power developed being, on the eight hours' test, 31,203 indicated horsepower, while the mean speed on four runs over the long deep-sea course was 23.5 knots. The design anticipated 23 knots, with the engines developing 30,000 indicated horsepower. The Leviathan is the second of the four vessels of the Drake class to be successfully passed through her steam trials, and, as on the occasion of the Good Hope's performance we wrote fully as to the chief elements of design, it is only necessary here to give one or two general particulars. The length is 500 feet, width 71 feet, and when in fighting trim she will displace 14,100 tons, the draught then being 26 feet. The vessel carries 2600 tons of fuel in her bunkers, and will therefore be able to steam at a cruising speed of 14 knots for 12,500 sea miles, equal to a voyage from Portsmouth to Melbourne, without renewing her fuel supply. The propelling machinery consists of two sets of four-cylinder triple-expansion engines;

each of the two sets is designed to develop 15,000 indicated horsepower, steam being supplied by 43 water-tube boilers of the latest Belleville economizer type, working at a pressure of 300 pounds per square inch. All the engine cylinders are fitted with separate liners and are steam-jacketed. The diameter of the high-pressure cylinder is 43½ inches, that of the intermediate cylinders 71 inches, and that of the two low-pressure cylinders 81½ inches, each having a stroke of 48 inches. The high-pressure cylinder is fitted with one piston valve of the inside type, the intermediate cylinder is fitted with two piston valves, having adjustable packing rings, whilst the two low-pressure cylinders are fitted with double-ported flat slide-valves, having a special type of relief ring. There are two air-pumps on each engine worked by levers in the usual manner from the main engines. The main condensers are four in number, of cast gun-metal, having a collective cooling surface of 32,000 square feet. There are two condensers to each set of engines—one forward and one aft, bolted to the back columns and resting on a seat. At the aft end of each engine-room is placed an auxiliary condenser, having a cooling surface of 1830 square feet. Under each auxiliary condenser is placed a combined air and circulating pump. Water is circulated through the main condensers by four 24-inch centrifugal circulating pumps, each driven by independent engines, having, in addition to the suctions from the sea, the usual bilge connections.

The boilers are placed in four separate compartments, there being in all eight stokeholds running athwartships. The forward group in each boiler-room consists of a single row of boilers, and the after group in each are placed back to back. There are thus 43 boilers with economizers—viz.: Five boilers having ten elements, with eight element economizers; 28 boilers having nine elements, with seven element economizers; and ten boilers having eight elements, with six element economizers. The total heating surface is 71,970 square feet, and the grate area 2310 square feet, the weight of machinery being approximately 2500 tons.

The armament includes two 9.2-inch guns, sixteen 6-inch guns, and a large number of 12-pounders and automatic guns. The main and auxiliary machinery and boilers and the magazines are protected by a water-line belt 11 feet 6 inches deep, extending over half the vessel's length, and varying in thickness from 6 inches amidships to 4 inches at the ends. At the after end of this belt a 5-inch armored bulkhead is fitted, and 2-inch nickel-steel protective plating is fitted on the bows. Abaft the screen bulkhead is a protective deck 2½ inches thick, affording protection to the steering gear and after capstan, etc. Within the citadel two protective decks are worked, the upper being 1½ inches thick, and the lower 1 inch thick. The 9.2-inch guns are protected by 6-inch barbettes, in addition to gun-shields. The 6-inch guns are each enclosed in a separate casemate, these being formed of 5-inch hard-faced armor. The conning-tower is of 12-inch armor, with an armored tube 7 inches thick, affording protection to the controlling gear, etc.

Turning now to the steam trials, it may be said at the outset that special interest attaches to these, as a change was made in the pitch of the propellers, so as to make possible a comparison of the results with those got with the Good Hope. Both ships are alike in form; the machinery is of the same dimensions, even to the propellers, which are 19 feet 2 inches in diameter. On the trials of the Good Hope the blades

were set at a pitch of 22 feet 9½ inches, and it was decided to give the Leviathan's propellers an altered pitch, which is now 23 feet 9½ inches, and to make observation of the result on the speed of the ship. It was not deemed necessary to make the same series of progressive speed trials as in the case of the Good Hope, and only at three speeds are data available—at 15¼ knots, which represents the rate for one-fifth power; at 22 knots, the speed at continuous steaming power; and at 23 knots. From the results set out in the appended Table I, it will be seen that although at full power there is a slight gain in speed in the case of the Leviathan, the Good Hope did a shade better for the same power at 22 knots; and as to slip, there is a rise to the same maximum at 23 knots, which characterized the progressive speed curve on page 349 *ante*. The revolutions of the Leviathan are also slightly less, as one would expect from the coarsening of the propeller pitch.

TABLE I.—MEAN RESULTS OF SPEED TRIALS OF H. M. SS. LEVIATHAN AND GOOD HOPE.

Revolutions.	Indicated Horsepower.	Speed in Knots.	Percentage of Slip.
	H. M. S. LEVIATHAN.		
71.2	6,481	15.238	8.5
107.6	22,900	21.96	13.8
122.1	31,592	23.25	18.7
	H. M. S. GOOD HOPE.		
77.5	7,953	15.92	8.4
109.1	22,467	22.10	9.6
126.2	31,088	23.05	18.5

The Leviathan's trials at 15 knots' speed were made over the measured mile in Stokes Bay at the top of the tide, the depth of water then being quite satisfactory for the speed and draught; but the other trials at 22 and 23 knots were made at the deep-sea course between Dodman and Rame Head. Four runs were made on each occasion, and we have set out the results of each run at full speed in Table II. There was a stiff beam wind blowing, and the first and third trips were made to the westward. The mean of means, as given in Table II, was 23.25 knots.

As to the steam performances of the machinery, little need be said. The boilers worked well throughout, and the full power—the greatest yet maintained in a warship on an 8-hour trial—was got with only .35 inch of air-pressure, which is far below the standard formerly set up as natural draught. The loss of water is an interesting feature. On the low-power trial it was 1500 cwt. per hour, which for 6372 indicated horsepower is quite satisfactory: at 22,882 indicated horsepower it was even proportionately less, being slightly over three tons per hour: and at full power it was practically at the rate of one ton per 8000 horsepower per hour, or four tons in all per hour. The absence of vibration was also an important point. The engines worked splendidly, and it will be noted from Table III, giving the results of all three trials, that the proportion of power by the respective cylinders was uniformly maintained. In the low-power trial, with a steam pressure of only 200 pounds, the

TABLE II.—H. M. S. Leviathan's Trials.—Mean Results of Four Runs over Deep-Sea Course (23 Knots) at Full Power on May 9.

		First Run.		Second Run.		Third Run.		Fourth Run.	
		Starboard.	Port.	Starboard.	Port.	Starboard.	Port.	Starboard.	Port.
Mean steam in boilers ..... lb.		....	....	....	....	....	....	285	285
Mean vacuum ..... in.		25⅛	25	25⅛	25⅛	25⅛	25⅛	25⅛	25⅛
" revolutions		121.3	120.7	123.7	123.7	123.6	121.9	120.9	121.0
Mean pressures in cylinders	High ..... lb.	111.6	106.7	113.5	109.4	113	109.1	109.8	106.5
	Intermediate .. "	39	39	39	38.7	39.1	37.7	38.8	37.6
	Low forward .. "	20.8	20.3	21.8	20.7	21.8	21.2	21.6	20.8
	" aft ..... "	20.1	20.4	21.3	20.7	21.1	20.9	20.9	20.8
Indicated horse-power	High	4,871	4,630	5,050	4,870	5,025	4,790	4,780	4,640
	Intermediate	4,545	4,505	4,620	4,590	4,621	4,402	4,510	4,370
	Low forward	3,182	3,085	3,395	3,220	3,394	3,250	3,290	3,175
	" aft	3,075	3,100	3,315	3,220	3,280	3,205	3,190	3,175
Total indicated horsepower		15,673	15,320	16,380	15,900	16 320	15,647	15,770	15,360
Gross total indicated horsepower		30,993		32,280		31,967		31,130	
Speed		23.26		22.98		23.63		22.88	

TABLE III.—Mean Results of the Steam Trial of H.M.S. Leviathan in the English Channel.

Date		May 13 and 14		May 15 and 16.		May 19.		
Natural duration of trial		30 hours coal consumption at one-fifth full power		30 hours coal consumption trial at ¾ full power		Eight hours trial		
		Forward.	Aft.	Forward.	Aft.	Forward.	Aft.	
Draught of water		26 ft. 1 in.	26 ft. 6 in.	26 ft. 2½ in.	26 ft. 3 in.	26 ft. 2 in.	26 ft. 2½ in.	
Steam in boilers		200 lb.		245 lb.		280 lb.		
		Starboard.	Port.	Starboard.	Port.	Starboard.	Port.	
Vacuum		26 in.	25 in.	26 in.	26 in.	25.6 in.	25.5 in.	
Revolutions per minute		70.6	70.9	107.3	107.0	121.2	120.8	
Mean pressure	High	51.86 lb.	49.11 lb.	97.8 lb.	95.6 lb.	111.0 lb.	106.8 lb.	
	Intermediate	13.68 "	11.80 "	34.7 "	34.9 "	39.0 "	38.3 "	
	Low forward	5.47 "	6.49 "	15.96 "	14.8 "	21.5 "	20.5 "	
	Low aft	5.00 "	6.24 "	15.32 "	15.0 "	20.7 "	20.7 "	
Indicated horsepower	High	1323	1253	3,779	3,686	4,847	4,649	
	Intermediate	929	802	3,575	3,589	4,530	4,446	
	Low forward	486	579	2,158	1,998	3,287	3,123	
	Low Aft	444	556	2,072	2,025	3,165	3,156	
Mean total indicated horsepower		3182	3190	11,584	11,298	15,829	15,374	
" collective indicated horsepower		6372		22,882		31,203		
" air pressure		Nil		Nil.		.35 in.		
Speed of vessel		15.238		21.96		23.25		
Coal consumption per indicated horsepower per hour		1.76 lb.		1.75 lb.		1.94 lb.		
Total loss of water		24 tons.		95 tons.		32 tons.		

low-pressure cylinder power was somewhat less relatively to the other cylinders than in the later trials. But the best proof that everything went well is the fact that the trials only occupied a week, the vessel returning to Portsmouth dockyard on Tuesday, to have her engines opened up for inspection and to be otherwise prepared for commission. —*Engineering*, May 23, 1902.

The London has got successfully through her trials, and in the eight hours' full power with 110 revolutions worked up to 15,264 indicated horsepower, with a mean speed of 18.1 knots. The Bulwark, her sister, attained 15,353 indicated horsepower = 18.15 knots, so that almost identical results have been obtained. Neither ship was much pressed. The contract demanded 15,000 indicated horsepower and 18 knots, and there was no attempt to see whether another knot could be forced out of them, as it probably could have been easily enough. No trouble was experienced with the London's Belleville boilers.

H. M. S. Prince of Wales, twin-screw, first-class barbette battleship, was launched on Tuesday, the 25th inst. The particulars are:

Length between perpendiculars	400 ft.
Breadth, extreme	75 ft.
Draught of water	Forward, 26 ft. 3 in.; aft, 27 ft. 3 in.
Displacement	15,000 tons.
Engines	Inverted, triple expansion.
Boilers	20 in number, Belleville type.
Indicated horsepower of engines	15,000.
Speed	18 knots.
Maker of engines	Greenock Foundry Co.
Coal stowage	1,920 tons.
Complement (exclusive of admiral and staff)	781.

Armament.—Four 12-inch breech-loading 50-ton wire guns; twelve 6-inch breech-loading guns; sixteen 12-pounder 12-cwt. guns; six 3-pounder Hotchkiss guns; two 12-pounder 8-cwt.; eight 303-inch Maxims; torpedo tubes (submerged), four; number of torpedoes—eighteen 18-inch; six 14-inch.

Armor.—On sides, 9 inches, 7 inches, 5 inches, and 3 inches; on bulkheads, 12 inches, 10 inches, and 9 inches; on barbettes, 12 inches, 8 inches, and 6 inches; casemates, 6 inches; fore conning-tower, 14 inches; communication tube, 2 inches; after conning-tower, 3 inches; communication tube, 3 inches; 12-inch gun shield, 10 inches and 8 inches; roof and floor, 3 inches; protective plating on bows, 2 inches.

Protective Deck-Plating.—Main deck, two thicknesses of 1 inch fore end of armor; bulkhead amidships, two thicknesses of ¾ inch forward: middle deck, two thicknesses of ½ inch from armor bulkhead to fore side of barbette, and two thicknesses of 1 inch on slope to lower deck. Slope over main machinery compartment, two thicknesses of 1 inch; lower deck, two thicknesses of ½ inch from slope to stem forward; and two thicknesses of 1 inch and 1½ inch abaft "A" bulkhead.

First keel-plate laid March 20, 1901.

Weight of hull when launched, 5000 tons.—*The Engineer*, March 28, 1902.

H. M. S. QUEEN.—On March 8 there was launched at Devonport the battleship Queen, a ship which is the embodiment of the latest developments in the design and construction of warships. The Queen is, to all intents, a ship of the London class; but, being later, embodies certain improvements. These may be tabulated as follows: (1) Limitation of ventilating cowls, which are now recognized as "shell-traps," (2) Substitution of an open for a closed 12-pounder battery amidships. (3) Substitution of stockless anchors for the old type anchor. In all other particulars data that apply to this ship apply with equal force to the London class. Particulars of the vessel are as follows:

Displacement	15,000 tons.
Length (between perpendiculars)	400 feet.
Beam	75 feet.
Draught (extreme)	29 feet.

Guns: Four 12-inch wire-wound, 50 tons.
Twelve 6-inch 45-caliber Vicker's.
Sixteen 12-pounder, 12-cwt.
Two 12-pounder, 8-cwt. (boat guns).
Six 3-pounder.
Eight Maxims.

Torpedo tubes: Four 18-inch submerged.

The armor consists of a Krupp cemented belt 15 feet wide, extending from the after bulkhead to the bow. It is 9 inches thick amidships, thins to 6 inches just by the fore barbette, and thence reduces to 2 inches at the extreme bow. It is 4 inches thick at 30 feet from the stem, and here the belt proper ends. The continuation is 2-inch nickel steel, and it is carried down over the ram point, thus giving great rigidity to a weapon that no warship is likely to use. Aft of the after bulkhead, up to the level of the lower deck, there is 1-inch nickel laid on the ½-inch skin plating, constituting a species of complete belt against small projectiles—three-pounders and the like. This protection is what has been termed "naval architect's armor"—that is to say, it has probably no practical value. Those who saw the Belleisle after her first battering will remember how the 12-inch armor amidships on that ship is holed in places like a honeycomb where three-pounders have hit and buried themselves in it. They did not penetrate, it is true, but they went in a good deal further than the value of 1 inch, or, for that matter, 2 inches of steel.

There are two armor decks. The upper one is flat, 1 inch thick of steel where the side armor is thickest, and 2 inches elsewhere. This armor deck runs along level with the top of the belt, and forms the main deck of the ship. Its object is to prevent shell bursting on the main deck inflicting damage below that level.

The second deck is the ordinary inclined deck reinforcing the belt. It springs from the lower edge of the belt amidship, and going up at a sharp angle, has a flat top about the lower deck level in the middle of the ship. Forward and aft it sinks more, and has less curve. This particular deck is common to all our warships, from the Majestic class

onward. The recent Belleisle experiments would seem to indicate that it is decidedly inferior to the French system of a flat deck below the belt, and there are grave doubts as to its efficacy, or rather as to whether the theoretical protection afforded is correct. In theory 2 inches inclined equal 4 inches vertical armor. In practice a shot falls obliquely, and so reinforces indirectly the side armor.

In theory a 9-inch belt like the Queen's, reinforced by a 2-inch belt, is worth as follows: 9-inch cemented Krupp $\times$ 3 = 27 inches of wrought iron; 2-inch deck $\times$ 2 inches for inclination $\times$ 2½ inches for material = 10 inches wrought iron. Total resisting value is, therefore, in theory, 37 inches of wrought iron plus the coal, which may be called another 3 inches; grand total, 40 inches. Practical value is probably nearer 30 inches, even allowing for the damage inflicted on the projectile by getting through the hard face of the outer plate. In battle, however, the ship will rarely present herself at anything but an angle to the hostile gun; this will render capped projectiles useless and increase the difficulties of others, from which it may be inferred that a 9-inch Krupp belt will keep out everything save the lucky shot at near range.

To resume. The barbettes of the Queen are 12 inches thick, non-cemented Krupp, equivalent in value to Harvey nickel. The turrets are Harvey nickel, 8 inches thick, inclined at an angle of about 35 degrees. Turrets of this form, we may observe, are general in every navy except the French, where the big ships adhere to vertical turrets. So far as we know, it has never occurred to anyone to submit these two rival systems to an experiment as to their relative values. Since, however, anything that hit a turret would send bolts and rivets flying inside, penetration may be of no importance, and the thickness or otherwise of the armor or its inclination alike immaterial. These turrets are avowedly for protection against small guns, and though the gun mountings of to-day embody all that human ingenuity can devise against the effect of shot, it is hardly conceivable that either guns or guns' crews will survive the fearful impact of a big projectile striking with an energy of at least 20,000 foot-tons, and possibly 30,000 to 40,000. The result seems bound to be something like hitting a clock with a hammer.

The Queen's secondary guns are in Krupp non-cemented casemates, 6 inches in front and 2½ inches in rear. They are situated like those of the London—in four rough groups of three—two on the main deck and one above between them, exposing its base to shell attack. This arrangement is supposed to lead to less "interference" than when the upper casemate is immediately above the other, as in cruisers. It is, however, a remarkable fact that all our battleships adhere to one system and all our cruisers to another. The Drake and Canopus have identical protection, so it would certainly be interesting to know why their casemates differ. Amongst naval officers there is a very strong feeling against the battleship disposition of casemates.

The machinery of the Queen is two sets of vertical triple-expansion engines, actuating twin screws turning inward. They are designed for 15,000 indicated horsepower, which is to give 18 knots and 110 revolutions. Steam is supplied by twenty Yarrow boilers. This will be the first use in the British navy of a British boiler that is the only one used at all in the Austrian, Dutch, Portuguese, Swedish, and Norwegian navies—a record of sole use such as no other water-tube boiler possesses. The coal supply is 900 tons normally, and 2100 tons maximum capacity.

Arcs of fire are: Big guns, about 130 degrees either side of the axial line; end-on casemates, 130 degrees from the axial line; other casemates, about 55 degrees before and abaft the beam. The armor weighs about 3000 tons; the weight of hull, including armor, etc., is 9985 tons. The 12-pounders are mounted, four on the main deck in the extreme bow, four distributed on the same deck aft, eight on the upper deck firing over the low bulwarks, two—the 8-cwt. "boat guns"—on the topside by the fore conning-tower.

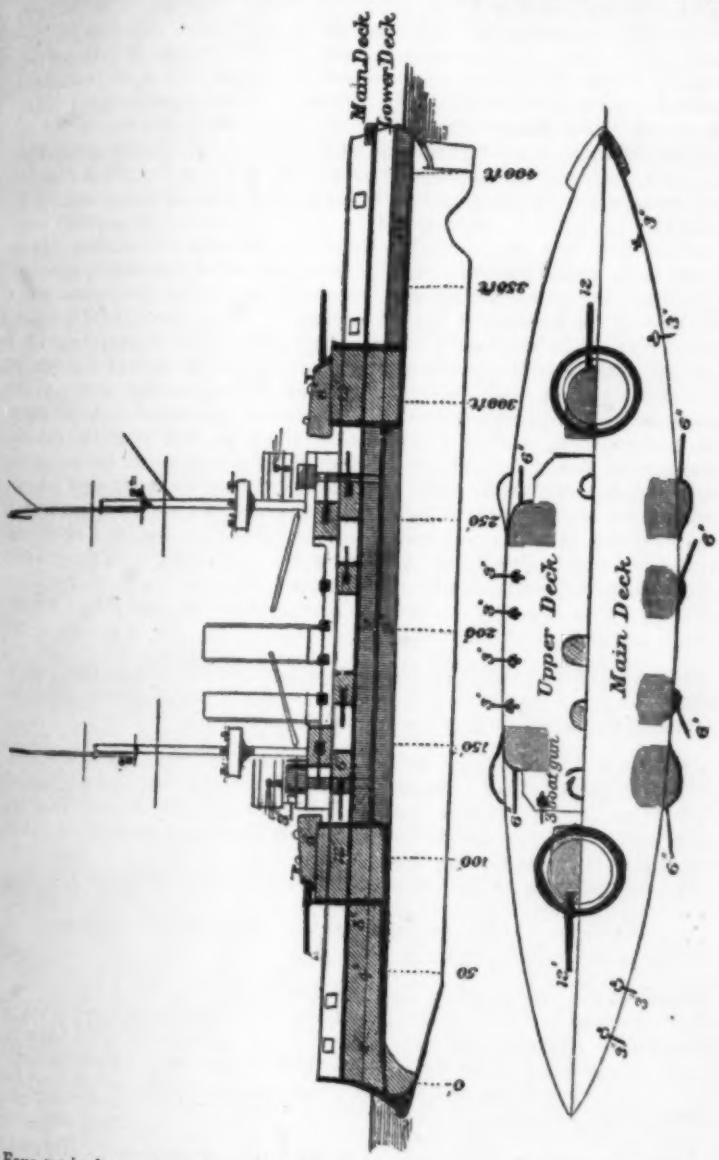
A proposal is afoot to replace some or all of the Queen's 6-inch guns by 7.5-inch pieces, and, in view of the present trend towards arming our ships as well as any possible enemies, this may very probably be attempted.

A 7.5-inch gun with mountings weighs approximately 27 tons, and its charge and projectile 256 pounds. With the new propellant some weight will be saved, and approximately 10 rounds go to the ton, and about 20 tons of ammunition are carried per gun at 200 rounds the gun. That is 240 tons for twelve guns, which, plus the weight of twelve guns and mounting—324 tons—comes to about 564 tons for an entire armament of 7.5-inch guns. To this we may add 75 tons for increased size of casemates, giving a grand total of 639 tons, which we may call 650 in round numbers. The 6-inch 45-calibers Vickers with its mounting, etc., weighs 9¼ tons. Weight for twelve guns is therefore 111 tons, against 324 tons. Ammunition runs at about 18 rounds to the ton; the total for all the secondary guns at 200 rounds we can put at 132 tons, giving a grand total of 143 tons for the present 6-inch armament, against 564 tons as an outside weight for one of 7.5-inch guns. The extra weight would then be about 421 tons.

Now, 50 tons, more or less, is a negligible weight in any of Sir William White's battleships—the margin in them being about 800 to 1000 tons in 15,000. By this we mean that all of them carry maximum coal without their speed being affected. To reduce the coal would not be politic perhaps, but the extra 420 tons odd would not very appreciably affect the speed of the Queen, while in any case she would consume coal enough to soon cover the difference. But the weight can be saved far more cheaply. The exact weight of "stores" carried is hard to get at, but since in dealing with a 15,000-ton total small fractions do not matter, we can arrive at an approximation sufficiently near. Something over two tons a day in the way of food, etc., are daily consumed by a battleship's crew. Much of it is in the way of food that is replenished weekly; but stores for six months are carried. If we assume these at a ton a day, we shall not probably be much more than a hundredweight or so out, and the total cannot be less than 200 tons. Probably, seeing that it includes many things beside food, 300 tons or more would be nearer the mark. Since a ship must coal at least once a month, a good three-quarters of these stores are deadweight of no value, and here alone nearly 200 tons could be saved.

Then, again, the 7.5-inch could do with less than 200 rounds. Fifty tons could be saved here. About fifty to a hundred tons of spare gear is quite unnecessary, and thus, without touching the coal, the extra 420-50 tons of 7.5-inch armament is sufficiently nearly covered to ensure no appreciable loss of speed. In addition, the 12-inch guns—each round for which weighs nearly half a ton—carry far more rounds than they could conceivably require. The Queen could not well mount more 6-inch

guns than she does—save by substituting a battery *à la* Mikasa—for the main deck casemates, and that means a heavy increase in weight.



Four 7.5-inch guns could replace four 6-inch guns at a cost of 160 tons, on which 10 tons of ammunition at least could be saved, and that extra

150 tons—which might conceivably be considerably less, for we have taken outside weights for the extra size of casemates—could be carried without the ship feeling it.

Our own impression is that, even did it necessitate reducing the coal supply by 400 tons, the change in armament would be a gain, for the burst of these 200-pound shells from the 7.5-inch gun is prodigious, while probable enemies all carry armor that the 7.5-inch could tackle where the 6-inch could not. There is a great deal of 5-inch armor on foreign ships, and the 7.5-inch in battle conditions should be superior to that armor, and go through it whenever it hit it seven times out of ten, while a 200-pound projectile at 2500 foot-seconds initial velocity is going to hit hard enough to make itself extremely unpleasant, even where it does not get through. Reflecting on this and kindred things, we strongly advise the Admiralty to take the bull by the horns and give the Queen the projected 7.5-inch guns. It is a thing that can be done, and since it can be done it should be done, for it is worth it. The 6-inch gun is either too small or too large for modern requirements, and only the fact that it is the smallest gun that can be trusted to fire lyddite that will detonate with certainty justifies its use at all. Two 4.7-inch would weigh no more, and do equal execution, save with lyddite, and shoot more truly at sea. They also threaten to land us in the *reductio ad absurdum*, for the 4-inch may be better still, and so on, till we get to the 3-pounder, the most deadly gun of any, if only its range were longer. Going upwards from the 6-inch, the 9.2-inch is barred from much employment on the score of weight, but the 7.5-inch is not, and we do not think there can be much question that a fire of six 7.5's from the Queen's broadside would match even the two 9.2's and five 6-inch of the King Edward. This six 6-inch would certainly fail to do.—*The Engineer*, March 7, 1902.

RUSSEL.—The battleship Russel has completed her official steam trials. With I. H. P. of 18,500 she made 19.3 knots for eight hours. The performance of her machinery gave great satisfaction.

MEDUSA—MEDIA.—The third-class cruiser Medusa, 2800 tons displacement, 9900 I. H. P., has been fitted with eight water-tube boilers of Dürr type. Her trials will soon be held. The Media, a sister ship, has undergone the same repairs, but Yarrow boilers have been placed in her. She will soon be ready for trial.

The second-class cruiser Arrogant, of 5750 tons and 10,290 I. H. P. is undergoing extensive repairs at Devonport.

The old boilers of the torpedo gunboat Seagull have been taken out and Niclausse boilers fitted in their place.

GOSSAWER.—The torpedo gunboat Gossawer completed her trials on May 12; these trials were satisfactory in all respects, a mean speed of 20.32 knots was attained with 6000 I. H. P. developed. This is an increase of two knots in speed and 2500 I. H. P. over her original performance, which was made possible by changing water-tube in place of her old boilers.

The destroyer Success completed her trials in February. Her mean speed for six runs over the measured mile was 30 knots, 6600 I. H. P. being developed.

Weakness has developed in the hull of the destroyer Wizard, which has caused this craft to be laid up to be strengthened. The loss of the Cobra has resulted in most critical examination of all of these small crafts for structural weaknesses.

SPRIGHTLY—LIVELY.—The torpedo-boat destroyer Sprightly of 300 tons displacement is completed and will soon have her trials. It is expected that she will develop over 6000 horsepower, and maintain a speed of over 30 knots per hour. Her sister ship the Lively recently had her trials, during which 6456 I. H. P. was developed, giving a speed of over 30 knots.

Recent reports indicate that the governments of Chili, Spain, and Japan are contemplating the purchase, in England, of submarine boats of the Holland type.

The torpedo-boat destroyer Express was ordered in 1896 and launched in 1897, and commenced her trials in 1898. She has since then had 37 trials, but has not yet been accepted. A speed of 33 knots is required.

One of the five submarine boats built at Barrow for the British Admiralty was put through further trials recently, had a trial speed on the surface, and had no difficulty in doing over ten miles an hour. She lies very low in the water, and can scarcely be discerned half a mile away. Everything apparently worked very smoothly. A new type of submarine ordered by the Admiralty from Messrs. Vickers, Sons and Maxim, is to be 100 feet long—37 feet longer than the other five—and will embrace some new departures in design and construction based on the experiments already made. She is to be ready and in working order to form one of the features of the Coronation naval review.—*Army and Navy Journal*, March 1, 1902.

On a recent trial at Barrow the British submarine No. 1 traveled six miles at a depth of fifteen feet under water. The automatic arrangement of displacement and compensation in this vessel, which enabled the commander to keep the ship a uniform depth under the water, were tested with the most satisfactory results. The vessel can maintain a speed of 8 knots, but when traveling with the turret "awash," this speed is considerably higher, and even with her engines going at full speed her balance is described as perfect.—*Army and Navy Journal*, May 10, 1902.

The British government has ordered the construction of four more submarine boats of the Holland type, making nine craft of this description that are being built. Another boat of another type is under construction, but the details of design have not been made public.

The gunboats Peacock, Pigeon, Pheasant, Widgeon, and Spider have been crossed off the effective list.

The Urgent, depot ship at Jamaica, is to be sold out of the service.

ITALY.

Budget proposals for the financial year 1902-1903. The budget as submitted to the Italian parliament is as follows:

Converted at £1 = 27 lire.

ORDINARY EXPENDITURE—GENERAL EXPENSES.

Admiralty	£	51,621
Pensions		207,111
Expenditures on various services connected with the mercantile marine		353,553
Total	£	612,285

EXPENDITURES FOR NAVAL SERVICES.

Ships fitting out, etc.	£	224,815
General staff of the navy		130,370
Corps of constructors		49,928
Commissariat service		30,704
Medical service		25,260
Wages—men		459,260
Gratuities		72,296
Assistants to constructors and others		54,940
Accountants, etc.		53,852
Police		11,326
Telegraph Service		9,037
Telegraph materials		6,555
Forts—personnel		12,964
Victualling		300,000
Lighting		7,704
Hospital services		20,296
Honorary distinctions		555
Fuel and stores, for ships in commission		255,555
Salaries and wages—workshops and fortifications		4,130
Training establishments		13,037
Naval Academy		3,625
Scientific services—personnel		1,374
Scientific services—matériel		9,444
Law charges		1,185
Travelling expenses		22,222
Transport of materials		4,629
Materials for repair of existing ships		207,925
Labor for maintenance of hulls and machinery		211,705
Materials for maintenance of ships and armaments		151,852
Guns, torpedoes, and small arms		81,481
Labor for construction and repair of armaments		82,334
Works department—repairs		92,592
Construction and completion of the following: First-class battleships Benedetto Brin, at Naples; Regina Margherita, at Spezia; Vittorio Emanuela, at Castellamare; Regina Elena, at Spezia. Armored cruiser Francesco Ferrucio, at Venice. Submarine boat, sundry small craft, laying down three first-class battleships of the Vittorio Emanuela class (A, B and C)		829,630

Fuel and stores, machines, tools, and plant for maintenance of ships; materials and labor	161,111
Total	£3,603,694

EXTRAORDINARY EXPENDITURES.

General expenses and half pay	£ 3,662
Expenditures on new construction	250,728
Coast defence and fortifications	7,407
Torpedoes	3,703
Total	£ 265,500

SUMMARY.

Ordinary expenditure—general expenses	£ 612,285
Expenditure of naval services	3,603,694
Extraordinary expenditure	265,500
Depreciation of ships in commission	129,629
Rent of lands occupied by government	98,740
Grand total	£4,709,848

—*Brassey's Annual*, 1902.

VESSELS BUILDING.

Name.	Displacement, tons.	Where Building.	Remarks.
Battleships.			
A	12,625	Government Yard, Spezia.	Just ordered.
B	12,625	Gov. Yard, Castellamare.	" "
C	12,625	.....	.....
Vittorio Emanuela	12,625	Government Yard, Spezia.	Not yet launched.
Regina Elena	12,625	Gov. Yard, Castellamare.	" " "
Benedetto Brin	13,526	" " "	Launched Nov. 7, 1901.
Regina Margherita	13,526	" " Spezia.	" May 30, 1901.
Armored Cruisers.			
Francesco Ferruccio	7,400	" " Venice.	Launched Apr. 30, (about) '02.
Torpedo Cruiser.			
Coatit	1,313	" " Castellamare.	Under trial.
Torpedo Boat Destroyers.			
Aquilone	360	C. T. T. Pattison, Naples.	Not yet launched.
Borea	360	" " "	" " "
Ostro	360	" " "	" " "
Tuono	360	" " "	" " "
Turbine	360	" " "	Under trial.
Nembo	360	" " "	Completed.
Torpedo Boats.			
T	..	.....	Not yet ordered.
T	..	.....	" " "
T	..	.....	" " "
T	..	.....	" " "
Submarine Boats.			
.....	..	Gov. Yard, Spezia (?).	Building.
Auxiliary Ships.			
Collier	..	.....	"
Collier	..	.....	"
Supply Ship	..	.....	Not yet ordered.

The Italian torpedo-boat destroyer Turbine which was recently completed at Naples, developed a speed on trial of over 30 knots an hour, with a very economical consumption of coal. Six of this type were ordered, but as yet only the Turbine and the Nembo have been completed.

The Regina Elena class are of a novel type. Their dimensions are: length, 435 feet 6 inches; beam, 73 feet 6 inches; draught aft, 27 feet 3 inches; displacement, 12,625 tons. The maximum thickness of belt armor is 10 inches; turret armor for principal guns, 8 inches thick; that on casemate and battery, 6 inches thick; protective deck on slopes, 4 inches thick. The armament comprises two 12-inch guns, mounted singly in turrets, forward and aft; twelve 8-inch Q. F., to be mounted in six turrets, three on each side; twelve 4-inch Q. F., and twelve 1.8-inch Q. F. Two thousand tons of coal may be carried.

The Italia is to have new boilers. She is to be fitted with 8 cylindrical and 16 locomotive boilers.

It is stated that the torpedo cruisers Monzambavo and Confienza are to be struck off the list this year.

The *Popolo Romano* announces that the armored cruiser Francesco Ferraccio will be launched at Venice on April 23. She is the sister of the Garibaldi and Varese and has been designed by Signor Masdea, now chief of the Technical Department of the Italian Ministry of Marine. The ship displaces 7460 tons, and is 344 feet long with 59 feet 9 inch beam, and 23 feet 4 inch draught. The hull is constructed entirely of steel, furnished by the National Steel Works. There is considerable subdivision into water-tight departments, and a partial double bottom. A protective deck is provided, and side armor is of Terni steel, 6 inches thick amidships, tapering towards the extremities, and rising to the level of the armored deck. There is thus complete protection for the dynamos, boilers, steering gear, magazines, dynamos, etc. A splinter deck is below the armored deck, and the space between them is partly occupied by reserve coal stores. The armament consists of one 10-inch gun in a barbette forward; two of 8-inch caliber coupled in a barbette aft; fourteen 6-inch guns, of which four with armored shields and ten in the battery; ten 2.9-inch, six 1.8-inch, and two machine guns. All the principal guns are from the Armstrong factory at Pozzuoli. The torpedo tubes are two, submerged. The machinery comprises two triple-expansion engines of 13,500 horsepower, with water-tube boilers. It has been constructed by Messrs. Hawthorn Guffy, of Naples. The intended speed is 20 knots.—*Army and Navy Gazette*, April 19, 1902.

JAPAN.

VESSELS BUILDING.

Name.	Displacement, tons.	Where Building.	Remarks.
Battleship.			
Mikasa	15,200	Barrow.....	Comp.; about to be delivered.
Protected Cruisers.			
Niitaka	3,365	Gov't. Yard, Yokosuka.	Building.
Tsushima	3,365	" " "	"

VESSELS BUILDING—*Continued.*

Name.	Displacement, tons.	Where Building.	Remarks.
Torpedo Boat Destroyers.			
Asashio	333	Thornycroft, England.	Nearing completion.
Ansgiro	375	Gov't. Yard, Yokosuka.	Not yet launched.
Harasame	375	" " "	" "
Hayatori	375	" " "	" "
Murasame	375	" " "	" "
I	..	.....	Turbine boat; projected.
I	..	.....	" " "
I	..	.....	" " "
Torpedo Boats.			
Awaiki	160	Gov't. Yard, Kure..... ...	Not yet launched.
Hato	150	" " "	" "
Hbari	150	" " "	" "
Kari	150	" " "	" "
Kiji	150	" " "	" "
Tsubame	150	" " "	" "
Hoshitaka	120	Kawasaki Works, Kobe.	Ordered.
Ouri	120	" " "	"
Kasume	120	Gov't. Yard, Kure.....	"
Sagi	120	" " "	"
Uzuri	120	" " "	"
87, 88, 89	80	" " "	Nearing completion.
80, 81	83	Kobe; built at Eibing in sections	Probably finished.
82, 83, 84, 85, 86	83	Sasebo; built at Poplar in sections.	" "
2 boats	88	Gov't. Yard, Sasebo.....	Ordered.
2 boats	88	" " Yokosuka ...	"

Reports from Tokio state that the new programme of naval expansion for the six years beginning 1904 will comprise four battleships of 15,000 tons each, two armored cruisers of 9900 tons each, four second-class cruisers of 5000 tons each, fifteen destroyers, and fifty torpedo boats.

The Japanese destroyer Asashio (Morning Tide) lately underwent a successful trial on the Maflin Sands. The speed attained as a mean of six runs was 31.057 knots. The mean revolutions of the main engines were 381.4 and the horsepower 7224. The mean speed for the three hours' run was 31.038. The Asashio is a sister vessel to the Shirakumo, both built by Messrs. Thornycroft. With the exception of the Albatross built by the same firm, these vessels are the fastest and largest destroyers afloat.

The latest 6-inch 50-caliber gun used in the Japanese navy is wire-wound for about half its length, and is from 5 to 10 calibers longer than those now in service. The total length is 309.73 inches; length of bore, 300 inches; weight of projectile, 100 pounds; weight of cordite charge, 29 pounds; weight of nitrocellulose charge, 47 pounds, corresponding velocities for both powders, 3000 foot-seconds; corresponding energy, 6240 tons; maximum pressure in gun, 15.5 tons; total weight of gun, 7.98 tons.—*The Engineer*, March 28, 1902.

It is stated that owing to the rapid increase of the Japanese navy, a deficiency of officers has arisen, and, that in order to meet the demand, the government has taken measures for the embodiment in the navy of military officers who may elect to make the transfer. They are to be commanded by their own officers, and are to undergo a course of two years in the fleet. After which they will pass an examination relating to all nautical matters, and upon passing will be finally appointed. Last autumn twenty-three military officers passed, and there are about fifty actually serving in the ships.—*Army and Navy Gazette*, April 5, 1902.

MOROCCO.

The cruiser El Baschir of 1200 tons displacement, 2500 H. P., 18 knots speed, built in 1892, has recently been sold to Colombia.

NETHERLANDS.

It is reported that a submarine boat of the Holland type is to be added to the Dutch navy.

The reconstruction of the coast-defense vessel, at Amsterdam, Koningin Regentes, has been completed. She displaces 4950 tons, and at 5300 I. H. P. has a speed of 16 knots. Her armament is two 9.4-inch guns, four 5.9-inch R. F., four 2.9-inch R. F., and eight 1.4-inch R. F. guns.

Yarrow boilers are to be supplied to the Hertog Hendrik. This ship is similar in all respects to the Koningin Regentes.

NORWAY.

It is probable that the Norwegian government will soon order the construction of a submarine boat at the Horten shipyard. This boat is of new design, the details of which have not yet been made public.

It is announced that the Norwegian committee which has been appointed to consider the question of submarine defence has reported in favor of the purchase of a Holland boat at the price of about 560,000 marks. The majority of the members of the committee express the opinion that submarine boats should be of great value for the protection of the coast of Norway.—*Army and Navy Gazette*, April 19, 1902.

PORTUGAL.

The old ironclad Vasco da Gama built in England in 1876, is to undergo reconstruction at Leghorn. She is to be lengthened 23 feet amidships.

The Portuguese government is investigating the merits of a submarine boat invented by Captain de Mello, of the Portuguese navy.

RUSSIA.

VESSELS BUILDING.

Name.	Displacement, tons.	Where Building.	Remarks.
Battleships.			
I.....	12,000	.....	Projected.
I.....	12,000	.....	"
I.....	12,000	.....	"
I.....	12,000	.....	"
I.....	12,000	.....	"
Slava.....	13,516	St. Petersburg.	Not yet launched.
Orel.....	13,516	"	Launched May, 1902.
Tsiesarevich.....	13,516	"	Not yet launched.
Borodino.....	13,516	"	Launched September 8, 1901.
Imperator Alexander III	13,516	"	" August 3, 1901.
Tsarevitch.....	12,900	La Seyne, France.	" February 23, 1901.
Tsiesa Potemkin Tavricheshy	12,585	Nicolaiev, Russia.	" October 9, 1900.
I.....	12,585	" "	Not yet launched.
Pobieda.....	12,674	St. Petersburg.	Nearly completed.
Oslabya.....	12,674	"	" "
Admiral Boutakov....	5,000	"	Not yet launched.
I.....	5,000	.....	Projected.
Cruisers.			
Bayan	7,800	La Seyne, France.	Launched June 12, 1901.
Bogatyr	6,750	Stettin, Germany.	" January 30, 1901.
Oleg.....	6,600	St. Petersburg.	Ordered.
Ragul.....	6,250	Nicolaiev, Russia.	Not yet launched.
Ochakov.....	6,250	Lazarev, "	" "
I.....	6,375	Libau, "	.....
Vitiaz	6,375	St. Petersburg.	Destroyed by fire June 13, '01.
I.....	6,375	"	Injured " " "
Askold.....	6,000	Kiel, Germany.	Launched March 13, 1900.
Aurora.....	6,630	St. Petersburg.	Injured by fire June 13, 1901.
Pallada.....	6,630	.....	Completed.
Diana.....	6,630	St. Petersburg.	"
I.....	.....	Schichau, Dantzic.	Not yet launched.
Boyarin.....	3,000	Copenhagen.	Launched June 8, 1901.
Kalgouia.....	3,200	Nicolaiev.	Not yet launched.
Almaz.....	3,200	St. Petersburg.	" "
Jemtchug.....	3,200	"	Ordered.
Izumrud.....	3,200	"	"
Miscellaneous.			
Kamchatka (Collier)..	7,200	St. Petersburg.	Not yet launched.
Imperial Yacht.....	(?)	(?)	No recent information.
Ozean	12,000	Kiel.	Launched February 8, 1902.
Torpedo Boat Destroyers.			
Bakian.....	350	St. Petersburg.	Launched August 12, 1901.
Bakan.....	350	"	Building.
Gorlitza.....	350	"	"
Kalik.....	350	"	"
Perepol.....	350	"	"
Skvoznie	350	"	"
Strij	350	"	"
Chtchegol.....	350	"	"
Albatross.....	350	"	"
Dzzad	350	"	"
Distel.....	350	"	"

VESSELS BUILDING—*Continued.*

Name.	Displacement, tons.	Where Building.	Remarks.
X.....	350	St. Petersburg.	Ordered.
X.....	350	"	"
X	350	"	"
X.....	350	"	.....
X.....	350	"	.....
X.....	350	"	.....
Ostotr.....	312	Havre.	Building.
Kefal.....	312	"	Launched November 28, 1901.
Filin	240	Ijora Works, Russia.	Practically complete.
Gagara..	240	" "	" "
Krecet.....	240	" "	Building.
Korsum.....	240	" "	"
Sowa.....	240	" "	Practically complete.
Voron	240	" "	" "
Berkut.....	250	" "	" "
Nyrok.....	250	" "	" "
Yastreb	250	" "	" "
Torpedo Boats.			
Akoula.....	150	St. Petersburg.	Launched August 24, 1901.
Bytchek..... ...	150	"	" " "
Keta.	150	"	Building.
Makrel.....	150	"	"
Nalim	150	"	"
Okun.....	150	"	"
Paltus.....	150	"	"
Pescar	150	"	"
Plotva.....	150	"	"
Sig	150	"	"
X.....	150	"	Ordered.
X.....	150	"	"
X.....	150	"	"
X.....	150	"	"
X.....	150	"	"
Submarine Boat.			
(Kuteinikov type.)	20	Kronstadt.	Ready for trial.

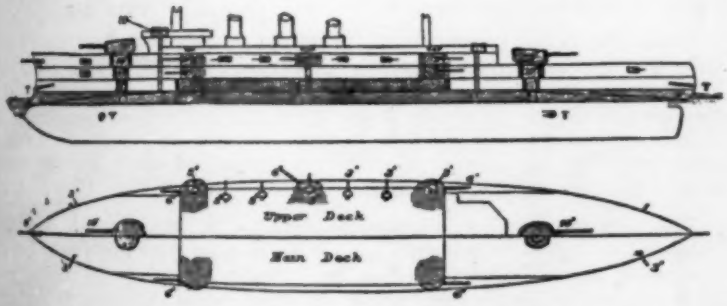
The Russian naval budget for 1902 shows an increase of over five million and a quarter roubles, 98,308,984 roubles as compared with 93,597,666 roubles in 1901. New naval construction takes up 36,903,856 roubles, but this will probably be increased by 15,000,000 roubles, as it is rumored that the Russian government intend devoting this sum to the building of new vessels. Two docks are to be built at Vladivostock, to the improvement of which 2,000,000 roubles is allotted. A dock is also contemplated for Port Arthur, the charges for which have risen from 1,500,000 roubles to 3,200,000 roubles. Five hundred thousand roubles is set apart for repairs to the establishment at Galerny Island, where it will be remembered the disastrous fire occurred which almost destroyed the new cruiser Vitiog, then in an advanced state of construction. Increased sums are to be spent upon the new artillery and torpedo divisions in the Baltic, and upon the training division in the Black Sea. Large sums are set apart for the purchase of Geissler apparatus for torpedo tube sand for torpedoes of a new pattern with the Obri apparatus. Since 1899 the personnel of the Russian navy has been increased by about 5000 men annually. In 1902 some 3000 will be added, making a total of

more than 60,000 altogether. It is announced that 43,122 of these will be employed on ships in commission during the present year.—*Marine Engineer*, May, 1902.

It is officially stated that no more Russian warships are to be built in foreign yards.

The old Russian battleship Tchesma has been re-engined and re-boilered, so as to undergo another term of service.

New regulations have recently been published relative to the Russian Volunteer Fleet, which are to remain in force until 1912. The management of the fleet is vested in a committee, which sits in St. Petersburg, and is subordinate to the Ministry of Marine, the president being an admiral on the active list. The officers, whether executive, medical or engineering, must either belong to the Imperial navy, or have been specially trained for their posts. Ships of the Volunteer Fleet are bound to make at least 18 voyages per annum to Vladivostock, from either Odessa or St. Petersburg, calling at least nine times at Port Arthur and nine times at Shanghai, and when required by the Ministry of War these voyages may be increased to any number within the capacity of the fleet. The ships have the right to carry passengers and merchandise, and are granted certain privileges over private vessels in connection with the transport of men and stores for the Ministry of Marine.—*United Service Gazette*, April 12, 1902.



The Russian battleship Pobiéda, see plans above, which has been undergoing construction at St. Petersburg, is nearing completion. Her length is 401 feet 3 inches; beam, 71 feet 6 inches; displacement, 12,674 tons; draught, 26 feet. She is protected by Harveyed armor 9½ inches thick on belt, 9 inches on gun positions, and 2¾-inch deck plating. Her armament comprises four 10-inch, eleven 6-inch Q. F_4, sixteen 3-inch, ten 1.8-inch, seventeen 1.4-inch, and two light guns. She is fitted with six torpedo tubes; 2056 tons of coal can be stowed. She has triple screws, and at 14,500 I. H. P. her speed will be 18 knots. Her complement is 732 officers and men.

The Imperator Alexander III, a battleship of 13,516 tons displacement, is practically completed, and will soon undergo her trials. The Borodino, a sister ship, is nearing completion.

The destroyer Lossos of 312 tons, 5700 horsepower, and 26 knots, has been launched in Havre.

The Sterliad, Osiotr, and Florel, destroyers built at Havre for the Russian government, have been completed and delivered.

OKEAN.—Quite a new type of auxiliary vessel was launched at Kiel on February 8 in the 18-knot ship Okean, of 12,000 tons displacement. She has three triple-expansion engines, boilers of each of the types most commonly found in men-of-war, and her object is to enable engineer officers and stokers to make themselves familiar with each type, and form an idea of their relative value. She will carry 4000 tons of coal, and a crew of 700 men.

Great activity in the construction of ships has been manifested in all yards where ships are building for the Russian government. This is due to government orders requiring the earliest possible delivery of all ships now under construction.

SUBMARINES.—The Russians are experimenting in the Black Sea with two submarines of entirely different types. The details of the designs of these boats have not yet been made public.

SPAIN.

It is stated that ammunition purchased by Spain from the Krupp Company has been defective. It is probable that this matter will be subjected to official investigation.

Newspaper reports say that the committee created by the Queen Regent will recommend the building of twelve battleships, four armored cruisers, twenty gunboats, sixteen torpedo boats, two transports, and two training ships.

It is estimated that it will take forty-two months to construct a battleship and thirty-six months a cruiser in Spain and thirty months elsewhere, to construct the battleship and twenty-four months the cruiser.

The armored cruisers which are building for the Spanish navy at Ferrol, Carraca, and Cartagena have been in hand over ten years; and a somewhat painful impression has been made by news that, owing to errors in design or construction, it has been found necessary to pull to pieces and entirely reconstruct the bows of the Cardinal Cisneros at Ferrol, and that probably the same will have to be done in the case of the Princesa de Asturias and the Cataluna at the other ports. It would appear that, during the long course of construction, officers have endeavored to utilize the progress in detail made in other navies, and have urged the introduction of innovations and improvements which have added weight, and involved practical reconstruction. The same thing has occurred in a lesser degree in France, and in former times in this country. But the cause of the evil in Spain is the long period during which the ships have been in hand.—*Army and Navy Gazette*, April 5, 1902.

SWEDEN.

The Swedish government has ordered Yarrow boilers to be fitted in all of the ships now under construction. These ships are described in Professional Notes of PROCEEDINGS No. 101.

Further intelligence has been received concerning the disastrous gun accident at the Bofors Works, Sweden. In this establishment six-inch guns in the turrets of the Thule Göta and Svea are being transformed in order to increase their rapidity of fire. The transformation consists in providing them with an inner tube and a new type of screw breech block. After experiments it was recognized that some modifications were necessary, and when these had been made further trials began on February 24. The first three rounds were successful, but at the fourth round when the gun was fired electrically the operator completed the electric circuit before the breech was properly closed, the result being that the whole charge and breech block were blown out to the rear, killing six men.—*Army and Navy Gazette*, March 22, 1902.

UNITED STATES.

VESSELS BUILDING (July 1, 1902).

GIVING PER CENT COMPLETED OF TOTAL WORK REQUIRED TO BUILD THEM.

Battleships.

No.	Name (displacement)	Per cent completed	No.	Name (displacement)	Per cent completed
10	Maine (12,000 tons)	91	14	Nebraska (14,600 tons)	0
11	Missouri (12,500)	66	15	Georgia (14,600)	11
12	Ohio (12,500)	60	16	New Jersey (14,600)	10
13	Virginia (14,600)	2	17	Rhode Island (14,600)	10

Armored Cruisers.

4	Pennsylvania (13,600 tons)	27	7	Colorado (13,600 tons)	30
5	West Virginia (13,600)	25	8	Maryland (13,600)	25
6	California (13,600)	6	9	South Dakota (13,600)	6

Protected Cruisers.

14	Denver (3,100 tons)	82	19	Cleveland (3,100 tons)	83
15	Des Moines (3,100)	72	20	St. Louis (9,600)	3
16	Chattanooga (3,100)	73	21	Milwaukee (9,600)	2
17	Galveston (3,100)	60	22	Charleston (9,600)	9
18	Tacoma (3,100)	50			

Monitors.

7	Arkansas (3,214 tons)	97	9	Florida (3,214 tons)	93
8	Nevada (3,214)	93	10	Wyoming (3,214)	89

Torpedo Boat Destroyers.

1	Bainbridge (420 tons)	99	9	McDonough (400 tons)	99
2	Barry (420)	99	10	Paul Jones (420)	94
3	Chauncey (420)	99	11	Perry (420)	99
4	Dale (420)	99	12	Preble (420)	98
5	Decatur (420)	Compl'd and deliv'd	13	Stewart (420)	74
6	Hopkins (408)	94	14	Truxton (433)	98
7	Hull (408)	92	15	Whipple (433)	95
8	Lawrence (400)	99	16	Worden (433)	93

Torpedo Boats.

29	Stringham (340 tons)	98	30	O'Brien (174)	99
30	Goldsborough (247.5)	96	33	Thornton (165)	Compl'd and deliv'd
27	Blakely (165)	99	34	Tingey (165)	74
28	DeLong (165)	99	35	Wilkes (165)	99
29	Nicholson (174)	99			

Submarine Torpedo Boats.

1	Plunger (120 tons)	95	6	Pike (120 tons)	80
2	Adder (120)	99	7	Porpoise (120)	98
4	Grampus (120)	89	8	Shark (120)	97
5	Moccasin	99			

THE NAVAL APPROPRIATION BILL.—The bill making appropriations for the naval service for the fiscal year ending June 30, 1903, H. R. 14046, was reported to the House by Mr. Foss from the Committee on Naval Affairs on April 28. The amount carried by the bill is $77,659,386.63, a decrease of $442,404.37 from last year's bill. The bill was committed to the Committee of the Whole House on the State of the Union.

The following table gives a comparative statement of the estimates of this year and the amounts embodied in this bill; omitting the cents:

NAVAL ESTABLISHMENT.

	Estimates, 1903.	Carried by Bill.
Pay of the Navy	$16,498,199	$16,138,199
Pay, miscellaneous	600,000	600,000
Contingent, Navy	10,000	10,000
Emergency	300,000	100,000
Total, Pay of Navy	$17,408,199	$16,848,199

BUREAU OF NAVIGATION.

Transport., recruit. and contingent	$ 275,000	$ 275,000
Gunnery exercises	12,000	12,000
Outfits for naval apprentices	117,000	117,000
Outfits for landsmen	225,000	225,000
Outfits on first enlistment	135,000	135,000
Maintenance of colliers	350,000	350,000
Training station, California	30,000	30,000
Training station, Rhode Island	56,600	55,000
Training station, Port Royal	45,000	
War College, Rhode Island	14,246	14,246
Naval Home, Philadelphia	76,425	76,425
Total, Bureau of Navigation	$ 1,336,271	$ 1,289,671

BUREAU OF ORDNANCE.

Ordnance, Ordnance stores	$ 800,000	$ 800,000
Reserve supply ammunition	500,000	500,000
Conversion of guns	25,000	25,000
Smokeless powder	500,000	500,000
Battery for Newark	175,000	175,000
Batteries, New Orleans and Albany	200,000	200,000
Cranes, Portsmouth	10,000	
Cranes, Boston	10,000	
Machine tools, Boston	5,000	
Equipment storehouse, N. Y.	11,000	11,000
Gun factory, Washington	50,000	
Steel-casting plant, Washington	10,000	10,000
Chemical laboratory	5,000	5,000
Machine tools, Pensacola	12,000	12,000
Machine tools, Puget Sound	50,000	50,000
Cranes, Puget Sound	10,000	
Machinery, Washington	50,000	50,000
Reserve guns, auxiliary cruisers	250,000	250,000
Reserve guns, ships of navy	500,000	250,000

	Estimates, 1903.	Carried by Bill.
Torpedo station, Newport	65,000	65,000
Naval militia	60,000	60,000
Repairs	30,000	30,000
Miscellaneous items	75,000	75,000
Civil establishments	41,706	41,006
Total, Bureau of Ordnance	$ 3,444,706	$ 3,109,006
BUREAU OF EQUIPMENT.		
Coal and transportation	$ 2,500,000	$ 2,500,000
Equipment of vessels	2,000,000	2,000,000
Ocean and lake surveys	100,000	100,000
Depots for coal		640,000
Maintenance for colliers, 1903	350,000	
Contingent	35,000	35,000
Civil establishment	33,002	31,202
Total, Bureau of Equipment	$ 5,018,002	$ 5,306,202
BUREAU OF YARDS AND DOCKS.		
Maintenance yards and docks	$ 600,000	$ 600,000
Contingent	50,000	40,000
Civil establishment	134,204	102,214
Total, Yards and Docks	$ 784,204	$ 742,214
PUBLIC WORKS, YARDS AND DOCKS.		
Portsmouth	$ 1,947,575	$ 672,075
Boston	1,570,200	702,700
Narragansett	200,000	
New London	51,000	41,000
New York	3,475,000	499,000
League Island	741,300	447,300
Washington	622,000	240,000
Norfolk	1,511,000	344,000
Key West	93,000	93,000
Mare Island	888,700	225,500
Puget Sound	1,169,500	748,500
Porto Rico	2,613,000	50,000
Pensacola	995,800	2,500
New Orleans	359,000	339,000
Four drydocks	1,050,000	1,050,000
Tutuila	108,000	93,000
Charleston	1,050,000	250,000
Repairs and preservation of yards	500,000	500,000
Cavite	381,000	233,500
Olongapo	1,443,000	
Guam	12,300	
Plans		30,000
Total, Pub. Works, Yards and Docks	$20,781,375	$ 6,561,075

PUBLIC WORKS, BUREAU OF NAVIGATION.

	Estimates, 1900.	Carried by Bill.
Naval Academy	$ 1,500,000	$ 500,000
Training station, Cal.	31,500	31,500
Training station, R. I.	114,280	114,280
Training station, Port Royal	159,750	
Naval War College	60,000	60,000
Total, Pub. Works, Bureau of Nav.	$ 1,865,530	$ 705,780

PUBLIC WORKS, BUREAU OF ORDNANCE.

Magazine, Iona Island	$ 49,500	$ 49,500
Magazine, Dover	93,800	80,000
Magazine, Fort Mifflin	5,000	5,000
Magazine, Norfolk	117,500	46,500
Torpedo station, Newport	32,000	28,000
Proving ground, Indian Head	27,000	23,000
Magazine, Portsmouth	400,000	
Magazine, Boston	500,000	
Shell house, Chelsea	8,000	
Quarters, Rose Island	5,200	5,200
Magazine, Fort La Fayette	35,000	25,000
Water system, Fort Norfolk	2,000	
St. Helena, Norfolk	2,300	
Magazine, Man Island	80,000	80,000
Magazine, Puget Sound	100,000	50,000
Total, Pub. Works, Bureau of Ord.	$ 1,457,300	$ 392,200

BUREAU OF MEDICINE AND SURGERY.

Medical Department	$ 100,000	$ 125,000
Naval hospital fund	40,000	40,000
Contingent	35,000	35,000
Repairs	20,000	30,000
Naval hospital, Canaco	50,000	50,000
Total, Bureau of Med. and Surg.	$ 245,000	$ 280,000

BUREAU OF SUPPLIES AND ACCOUNTS.

Provisions, Navy	$ 4,000,000	$ 3,500,000
Contingent	250,000	200,000
Civil establishment	117,590	103,932
Total, Bureau of Supplies and Accts.	$ 4,367,590	$ 3,803,932

BUREAU OF CONSTRUCTION AND REPAIR.

Construction and repair vessels	$ 9,000,000	$ 8,000,000
Improvements, construction plants:		
Portsmouth	30,000	30,000
Boston	50,000	50,000
New York	50,000	50,000
League Island	50,000	50,000
Norfolk	50,000	50,000

	Estimates, 1903.	Carried by Bill.
Mare Island	50,000	50,000
Puget Sound	75,000	75,000
New Orleans	15,000	15,000
Charleston	50,000	
Philippine	50,000	50,000
Derrick, New York	35,000	
Derrick, Cavite	45,000	
Lighters, Mare Island	70,000	
Four steel tugs	280,000	140,000
Civil establishment	25,824	25,824
Total, Bureau of Con. and Rep.	$9,925,824	$ 8,585,824
BUREAU OF STEAM ENGINEERING.		
Steam machinery	$ 3,450,000	$ 3,405,000
Contingent	1,000	1,000
Machine plant:		
Portsmouth	100,000	
League Island	130,000	130,000
Norfolk	25,000	25,000
Mare Island	80,000	80,000
Puget Sound	125,000	125,000
Building experimental station	400,000	200,000
Civil establishment	23,000	17,900
Total, Bureau of Steam Eng.	$ 4,289,000	$ 3,983,900
NAVAL ACADEMY.		
Pay of professors and others	$ 68,991	$ 55,191
Pay watchmen, mechanics and others	46,259	46,259
Pay steam employees	11,154	11,154
Catboats	4,500	4,500
Repairs	31,000	31,000
Heating and lighting	20,000	20,000
Contingent	61,800	61,800
Total, Naval Academy	$ 243,705	$ 229,905
MARINE CORPS.		
Pay	$ 1,707,649	$ 1,707,649
Provisions	396,071	396,071
Clothing	340,000	340,000
Fuel	35,000	35,000
Military stores	40,297	40,297
Transportation and recruiting	100,000	100,000
Repair Barracks	50,000	50,500
Forage	6,000	11,000
Hire quarters	20,748	20,748
Contingent	91,700	91,700
Public works	206,000	145,500
Total, Marine Corps	$ 2,993,465	$ 2,938,465

INCREASE OF THE NAVY

	Estimates, 1903.	Carried by Bill.
Construction and machinery	$17,303,010	$13,303,010
Armor and armament	6,000,000	9,000,000
Equipment	400,000	400,000
Equipping navy yards		175,000
Grand total	$98,910,984	$77,659,386

The following appropriations have been increased over last year: Pay of Navy, $937,915; Bureau of Navigation, $243,046.25; Ordnance, $525,551; Equipment, $541,000; Yards and Docks, $90,000; Public Works, Ordnance, $741,000; Medicine and Surgery, $70,000; Supplies and Accounts, $260,083; Construction and Repair, $1,225,000; Steam Engineering, $521,000. The following are the reductions: Emergency Fund, $150,000; Naval Academy, $2,500,000; Public Works, Yards and Docks, $214,935; Increase of Navy, $2,696,990.

The provisos which appear in the bill, other than the routine ones which appear each year, are as follows:

Under Pay, Miscellaneous, it is provided, "That hereafter in cases where orders are given to officers of the navy or marine corps for travel performed repeatedly between two or more places in such vicinity as in the discretion of the Secretary of the Navy is appropriate, he may direct that actual and necessary expenses only be allowed."

Under Emergency Fund, Navy Department, it is provided, "That the accounting officers of the Treasury are hereby authorized and directed to allow, in the settlement of the accounts of disbursing officers involved, payments made under the appropriation 'Emergency Fund' to civilian employees appointed by the Navy Department for duty in and serving at naval stations maintained in the island possessions during the fiscal year 1902, and until such time as Congress shall make specific appropriation for the pay of such employees."

Under Public Works—Bureau of Ordnance, the Secretary of the Navy is "directed to appoint a board of naval officers whose duty it shall be to recommend a suitable site or sites for one naval magazine on the New England coast, between Boston and Portsmouth, suitable for the use of the Boston and Portsmouth Navy Yards, and if upon private land, to estimate its value and ascertain as nearly as practicable the cost for which it can be purchased or acquired, and also to estimate the cost of necessary buildings, grading and filling in, building roads and walks, improvement of water front, necessary wharves and cranes, railroad tracks and rolling stock, fire and water service, and for general equipment of said naval magazine. The board shall make a full and detailed report to the Secretary of the Navy, who shall transmit such report, with his recommendations thereon, to the next session of Congress."

Under Provisions, Navy, Section 1580 of the Revised Statutes is amended to read as follows:

Sec. 1580. The navy ration shall consist of the following daily allowance of provisions to each person: One pound and a quarter salt or smoked meat, with three ounces of dried or six ounces of canned fruit, and three gills of beans or peas, or twelve ounces of flour; or one pound of preserved meat, with three ounces of dried or six ounces of canned

fruit, and twelve ounces of rice or eight ounces of canned vegetables or four ounces of desiccated vegetables; together with one pound of biscuit, two ounces of butter, four ounces of sugar, two ounces of coffee or cocoa or one-half ounce of tea and one ounce of condensed milk or evaporated cream; and a weekly allowance of one-half pound of macaroni, four ounces of cheese, four ounces of tomatoes, one-half pint of vinegar, one-half pint of pickles, one-half pint of molasses, four ounces of salt, one-quarter ounce of pepper, and one-half ounce of dry mustard. Five pounds of lard or a suitable substitute shall be allowed for every hundred pounds of flour issued as bread, and such quantities of yeast as may be necessary."

Section 1581, Revised Statutes, is also amended to read as follows: "Sec. 1581. The following substitution for the components of the ration may be made when deemed necessary by the senior officer present in command: For one and one-quarter pounds of salt or smoked meat or one pound of preserved meat, one and three-quarters pounds of fresh meat; in lieu of the article usually issued with salt, smoked, or preserved meat, fresh vegetables of equal value; for one pound of biscuit, one and one-quarter pounds of soft bread, or eighteen ounces of flour; for three gills of beans or peas, twelve ounces of flour or rice or eight ounces of canned vegetables, and for twelve ounces of flour or rice or eight ounces of canned vegetables, three gills of beans or peas."

It is also provided, "that an extra allowance of one ounce of coffee or cocoa, two ounces of sugar, four ounces of hard bread or its equivalent, and four ounces of preserved meat or its equivalent shall be allowed to enlisted men of the engineer and dynamo force when standing night watches between eight o'clock postmeridian and eight o'clock antemeridian under steam."

Section 1584, Revised Statutes, and so much of the Act of May 3, 1880, "making appropriations for the naval service for the fiscal year ending June 30, 1881, and for other purposes," as authorizes the Secretary of the Navy to substitute desiccated tomatoes for desiccated potatoes, are repealed, and it is provided, "that money accruing from the rations of enlisted men commuted for the benefit of any mess may be paid on public bills to the commissary officer by the pay officer having their accounts."

Under the Contingent, Naval Academy, it is provided "that the Superintendent of the Naval Academy is authorized to pay Mr. Walter L. Steward, from the appropriation 'Contingent, Naval Academy' the sum of $40 to reimburse him for damage done to his crops during a battalion drill of the cadets."

Also, "that the appointment of five hundred additional cadets at the Naval Academy, Annapolis, Maryland, under such detailed rules and regulations as the Secretary of the Navy shall prescribe, is hereby authorized, such appointments to be made as follows: Each Senator and each Member and Delegate of the House of Representatives, according to the apportionment fixed by the Act approved Jan. 16, 1901, shall nominate one cadet and a sufficient number of alternates, and twenty-four cadets shall be appointed at large by the President. Of the whole number of additional cadets hereby authorized 125 shall be appointed annually during the four years next succeeding the passage of this Act. During the first year there shall be made one appointment upon the nomination of each Senator; one-fourth of the appointments allotted to the President; and a sufficient number upon the nomination of Members and Delegates

to make up a total number of additional appointments hereby authorized shall have been made, the President shall appoint one-fourth of the number herein allotted to him, and a sufficient number of appointments shall be made upon the nomination of Members and Delegates to bring the total to 125 for each year. Provided, That the Congressional districts for which appointments shall be made by the said members in any one year shall be determined by the Secretary of the Navy. And provided further, that the nomination of candidates for appointment as additional cadets as herein authorized shall be made before the first day of July of each year; and if the nomination from any State or district shall not have been made on that date, the Secretary of the Navy shall fill the vacancy by the appointment of an actual resident of the State or district, as the case may be, in which the vacancy exists, subject to the provisions of existing laws."

Under Provisions, Marine Corps, it is provided, "that when it is impracticable or the expense is found greater to supply marines serving on shore duty in the island possessions and on foreign stations with the army ration or commutation therefor."

The following clauses are included under Increase of the Navy:

"That for the purpose of further increasing the naval establishment of the United States the President is hereby authorized to have constructed by contract, except as herein otherwise provided, two first-class battleships carrying the heaviest armor and most powerful ordnance for vessels of their class upon a trial displacement of about 16,000 tons, and to have the highest practicable speed and great radius of action, and to cost when built by contract, exclusive of armor and armament, not exceeding $4,212,000 each; two first-class armored cruisers of about 14,500 tons trial displacement, carrying the heaviest armor and most powerful armament for vessels of their class, and to have the highest practicable speed and great radius of action, and to cost, when built by contract, exclusive of armor and armament, not exceeding $4,659,000 each; two gunboats of about 1000 tons trial displacement, to cost, when built by contract, exclusive of armament, not exceeding $382,000 each.

"It is further provided that the Secretary of the Navy may, in his discretion, and so far as may in his judgment be practicable, direct that any or all of the vessels herein authorized be built in such navy yards as he may designate: Provided, That the Secretary of the Navy shall build at least one of the battleships or one of the armored cruisers herein authorized in such navy yards as he may designate.

"And for the purpose of preparing and equipping such navy yard or navy yards as may be so designated for the construction of such ship or ships the sum of $175,000 or so much thereof as may be necessary, is hereby appropriated for each of the navy yards in which the Secretary of the Navy may direct any such ship or ships to be built.

"The Secretary of the Navy is hereby instructed to keep an accurate account of the cost of inspection and construction of such ship or ships, whether built in government yards or by contract, and report thereon to Congress at each session the progress of work and cost thereof, including the inspection of all the material going into the construction of such ship or ships, and upon the completion thereof to report a full and detailed statement showing the relative cost of inspection and construction in government yards and by contract."

The House Naval Committee in its report says of the provision for a board to recommend a site for a naval training station on the Great

Lakes: "It is believed that the establishment of a naval training station on the Lakes will have the effect of drawing into our navy a great many strong and sturdy young men from the fields and farms of the middle West who will make excellent seamen."

Of the increase of $525,551 in the appropriation for the Bureau of Ordnance, over that of last year, the Committee says that it is in part due to the $300,000 to be used for target practice, and adds that "the importance of target practice cannot be overestimated."

The next important item in the Bureau of Ordnance showing an increase over that of last year is an appropriation of $175,000 for new and improved batteries for the Newark, New Orleans and Albany. The batteries on these foreign-built vessels differ from our own, requiring special ammunition, and it is a source of great inconvenience to keep them supplied. It is believed by the Department that they should carry the standard United States Navy guns. The next new and important item in this Bureau is that of $250,000 for the purchase and manufacture of reserve guns for the ships of the navy.

Under Public Works, Bureau of Yards and Docks, the estimates called for $20,781,375, which was reduced by the Committee to $6,561,075. Naval station at San Juan, P. R., at Olongapo, P. I., housing and storing torpedo vessels at Boston, New York, Charleston, S. C., Pensacola and Mare Island, and other items, such as the purchase of land at New York, Norfolk, League Island and Mare Island, and storehouses to be established at the different navy yards, were all considered by the committee as matters which might be delayed for further consideration without in any way injuring the efficiency of the naval service.

As to the provision authorizing the Secretary of the Navy to appoint a board of naval officers to recommend a site or sites for one naval magazine on the New England coast and to make report to Congress at its next session, it is explained that among the estimates were recommendations from the Department for a naval magazine at Portsmouth approximately to cost $400,000, and Boston $500,000; but in view of the fact that these two navy yards are within a short distance of each other, about 40 miles apart, it is thought that possibly one magazine might answer for both.

"The Chief of the Bureau of Navigation," the report says, "estimates that to provide for the manning of our ships now under construction we will need approximately 14,000 men. Under the appropriation act of last year we provided 5000 of these, who are now under training, and in this year's bill is a further increase of 3000, which is all that will be necessary at the present time."

Commenting on the proposed increase in the navy a table is given showing the approximate cost of a battleship of 16,000 tons to be $7,532,777; of an armored cruiser of 14,500 tons, $6,714,288 and a gunboat of 1000 tons, $510,748, and the committee adds that it is of the opinion that in recommending its naval program it is "making a substantial and healthy increase of our navy, and one which will meet everywhere with popular favor." It is shown that vessels of the new navy, built since 1882 and completed to Dec. 31, 1901, number 79, and have cost $124,899,091.89. Of these, 24 are torpedo boats and 55 are vessels of other classes. The vessels building number 59, and of these 32 are torpedo boats and destroyers, leaving 27 vessels of other classes. The estimated cost of completing these vessels is (June 30, 1900), $110,183,118. There-

fore the total number of vessels of the navy, built and building, is 138, of which 56 are torpedo boats and destroyers, and the total cost will be $235,082,209.89.

A statement showing the value of real estate and chattels and machinery plant at the several navy yards and stations on June 30, 1901, shows a total of $71,409,162.21 for real estate and chattels, and $7,559,451.72 for machinery.—*Army and Navy Journal*, May 3, 1902.

As finally passed some changes were made in the bill. The amount appropriated remained the same. The title of "naval cadet" is changed to "midshipman," the corps of cadets is increased by 95. One of the battleships authorized is to be built at the navy yard, New York.

Oil as Fuel for Navies.—At a recent meeting of the British Institution of Naval Architects there was an extended discussion of liquid fuels for naval purposes. Sir Fortescue Flannery read an elaborate paper claiming that oil was preferable to coal, its relative value being as three to two. Dr. Edgar followed with an address in which he declared that the use of oil was certainly coming to the front, but he was unwilling to accept Sir Fortescue Flannery's figures as decisive. He thought it was safer to depend on coal rather than upon oil for the best results. Mr. Yarrow expressed the opinion that on first-class torpedo boats oil as fuel could be employed most usefully and economically to supplement coal. He did not think that sufficient experience had been yet gained to warrant the introduction of oil fuel furnaces into large vessels generally; but he considered that they, as accessories, might advantageously and economically be added to small vessels.

Admiral Fremantle objected to the use of oil fuel on account of the thick volumes of foul smoke which were the result of the fuel. He would like to know whether the same effects were always to be anticipated.

Colonel Swan thought that many of the objectionable features which were associated with the employment of oil fuel, on the Caspian Sea notably, were due to the crudeness of the arrangements made for furnaces and burners in the Russian steamers. If the relative figures as to efficiency, given in the papers, were correct, a great result had been obtained. The economy of space secured by the reductions in bunker space, etc., was of great importance. Herr Gimball said that he should like to know what the evaporating power of the oil fuel was. Sir F. Flannery replied that it was very high. Mr. Melville, inspector of machinery, observed that only the advantages of the use of oil fuel had been put before the meeting. There were grave disadvantages. One was the destructive effect upon the boilers of the entry of water mixed with the oil fuel. He had been experimenting for some time with oil fuel, but had not obtained such good results as those set forth in the paper. The smoke created by the use of oil fuel is very dense at most times, and it is difficult to prevent. Great space in the furnaces is required for perfect combustion, and the arrangements to meet this want create inconceivable difficulties.

The renewed interest in the question of liquid fuel for naval purposes has taken a far more practical form in the United States than it has in England. As we pointed out in these columns on February 22 of the present year, Admiral Melville is about to institute a series of comprehensive experiments to ascertain the relative value of coal and oil for fuel purposes. Admiral Melville holds that, inasmuch as petroleum con-

tains the heat units necessary to produce rapid combustion, its value as a generator of steam should be carefully investigated, and with the advent of the tubular boiler he believes that it is possible to devise a form of furnace capable of yielding better results with oil than have ever been obtained. Of one thing we may be assured, namely, that Admiral Melville's tests will be so intelligent, so thorough and so free from prejudice either for or against liquid fuel, that his verdict will be accepted as virtually settling the question. At intervals ever since 1866 the adaptability of petroleum as fuel for warships has received the serious attention of the Navy Department. In 1866, in 1879 and for three years following, extended tests looking to the use of oil were conducted at the New York navy yard but the results in all of them were unsatisfactory and inconclusive. But with the introduction of new types of boilers, and furnaces it is entirely possible that appliances may be devised whereby former difficulties can be overcome and petroleum successfully used in generating steam.

One of the early experiments with petroleum as fuel for naval uses is described in the *Army and Navy Journal* of June 22, 1867. Eight days before that date the U. S. S. Palos, a small gunboat, which had been fitted with apparatus for burning oil, left Boston navy yard and made a trip of twelve and a half miles to sea and return in one hour and fifty-five minutes. In forty-eight minutes she ran eleven and a half knots, whereas her best record with coal as fuel was eight knots an hour. When using coal the Palos required twenty firemen and coal passers, but with oil she needed only three men in the fire room. The petroleum was supplied from two large iron tanks placed on deck, each with a gauge at its side to indicate the volume of its contents, and a vent pipe on top to permit the escape of vapor. From these tanks the petroleum was conducted by half-inch pipes to the boiler furnaces where it dropped into heated retorts of iron where it instantly vaporized. This vapor was burned under the boilers after being mixed with steam which had been decomposed by passing it through pipes partly filled with iron filings. To this mixture or vaporized petroleum and decomposed steam there was also added a percentage of oxygen supplied by atmospheric air forced in by an ordinary air pump. "The heat thus generated," says our report of 1867, "is intense, and it is a noticeable fact that the combustion is so perfect that no smoke is perceptible. A diminution of the supply of air or steam at once creates a smoke."—*Army and Navy Journal*, May 3, 1902.

The U. S. training ship Monongahela is to be repaired previous to going on her usual summer cruise with the naval apprentices, and the time allowed for these repairs is thirty working days from the time of commencement.—*Army and Navy Journal*, May 3, 1902.

Increase of the Navy.—The Secretary of the Navy on Feb. 7 transmitted to the President of the Senate a report prepared by Rear-Admiral A. S. Kenny, Paymaster-General, U. S. N., in compliance with a Senate resolution calling upon the department to furnish information showing the amounts authorized for new vessels under "Increase of the Navy" in each act of Congress since and including the act of March 3, 1883, together with the vessels authorized, the amounts appropriated, total cost of finished vessels to June 30, 1900, and the estimated amount to be expended upon unfinished vessels from that date.

From March 3, 1883, to June 30, 1900, 77 vessels were added to the navy.

The total amount authorized for these vessels was $87,004,056.96.

Amount appropriated for hulls and machinery, $81,576,687.10.

Amount appropriated for armor, armament and equipment, $41,982,910.

Total contract price $59,458,852.

Amount paid under contract for hulls and machinery, $45,621,720.72.

Extras paid to contractors: Bureau of Construction and Repairs, $2,557,890.88; Bureau of Steam Engineering, $70,242.81.

Work done by the Government: Bureau of Equipment, $432,801.66; Bureau of Ordnance, $2,164,600.82; Bureau of Construction and Repair, $14,276,119.41; Bureau of Steam Engineering, $4,580,920.83.

Total cost of finished vessels, $99,803,528.30.

Cost of repairs since completion, $9,343,235.16.

Total cost of equipage, $13,759,572.28.

The unfinished vessels covered by the report number 72.

Whole amount authorized for these vessels, $80,180,800.

For hulls and machinery, $32,381,574.

For armor, armament and equipment, $16,377,800.

Total contract price, $47,618,166.

Expended for hulls, machinery and armor to June 30, 1900, $25,796,965.56.

Estimated amounts to be spent from June 30, 1900: Bureau of Equipment, $1,421,500; Bureau of Ordnance, $47,538,220; Bureau of Construction and Repair, $46,601,477; Bureau of Steam Engineering, $26,333,173.

Total estimated cost, $147,691,335.56.

The total number of inspectors, draftsmen, skilled laborers and other persons employed in drafting rooms and clerical departments at the various shipbuilding plants and navy yards, during the year 1900, was 639 and the cost of the service thus described from 1883 to 1900 inclusive was $4,049,405.39.

NEW SHIPS.—This year's Naval Appropriation Bill increases the navy by two battleships, two armored cruisers and two gunboats. The plans of these ships have already been worked out, and there has been much official discussion upon them. It will be remembered that last year's bill did not provide for any new ships, but required that plans be made for the most powerful class of battleships and of armored cruisers. The British experts declare that these plans call for ships that will be as powerful as those of the King Edward VII class, and that there are no other ships, built, building, or contemplated that have anywhere near the powers of offense or defense.

The battleships are to be 450 feet long, 76 feet 8 inches wide, of 16,000 tons trial displacement, 17,604 tons maximum displacement, 26 feet 9 inches maximum draught, will carry 2200 tons of coal, have an indicated horsepower of 16,500 tons and a trial speed of not less than 18 knots. The battery will consist of four 12-inch guns, eight 8-inch guns, twelve 7-inch guns, twenty 3-inch, twelve 3-pounders and eighteen smaller guns. The armor belt is 3 feet 3 inches wide and tapers from 11 inches amidships to 4 inches at the stem and the stern. The 12-inch barbettes are 10 inches thick, and the armor on the 12-inch turrets is 9 inches thick with 11-inch port plates. Quarters are provided for officers and crew numbering 797.

The new armored cruisers are far superior to many of the old battleships. In action it is probable that they would make short work of battleships of the Royal Sovereign or Oregon classes.

The plans for the new armored cruisers contemplate vessels 502 feet long on the load water-line, having a breadth of 78 feet 8½ inches, a trial displacement of about 14,500 tons, a maximum displacement at full load of about 15,959 tons, a maximum draught of about 27 feet, indicated horsepower of 25,000, and trial speed of not less than 22 knots. The armament will consist of four 10-inch rifles, sixteen 6-inch, twenty-two 3-inch, twelve 3-pounders and fourteen smaller guns. The armored water-line belt will be 7 feet 6 inches wide, having a maximum thickness of 6 inches over the vitals and tapering to 3 inches at the ends. The barbettes for the 10-inch turrets taper from 7 inches to 4 inches in thickness; the turrets of the 10-inch guns are 8 inches thick, with 9-inch port plates. The conning-tower and its shield are 9 inches thick. Each vessel is designed to carry 854 officers and men.

STRATEGIC VALUE OF THE ANTILLES.—With the acquisition of Porto Rico, the purchase of the Danish islands—which appears to be virtually a fact accomplished—and the intimate relations which have grown up between the United States and Cuba, our government has acquired a foothold in West Indian waters from which it seems destined to exert a commanding influence upon future naval and commercial operations in the Western hemisphere. These acquisitions have naturally preceded the construction of the Isthmian Canal and are logical steps toward the execution of that great project. And when the canal is completed, the United States will be found in positions to control the only three breaks in the northern barrier which enclose the Caribbean Sea from the Atlantic ocean. Through these channels and to and fro in the canal itself must flow the enormous commerce passing between Europe and the Orient. These passages—the Windward, between Cuba and Hayti, the Mona, between Porto Rico and the Danish West Indies—are all comparatively narrow and each is already the highway of a great commerce. The narrowest of all is the Anegada, which affords the shortest route from Europe to the mouth of the Isthmian Canal while the shortest approach from the Atlantic ports of the United States will be through the Windward and the Mona passages. With these channels controlled by us, as they certainly will be, the influence of the United States in the Caribbean will be indisputable.

Important as American control over these passages is in a commercial sense, it is their strategic value for naval purposes that appeals most strongly to those concerned in the development of our sea power. The construction of an Isthmian canal would add enormously to our ocean commerce, but if we build the canal safety demands that we shall control its approaches. To control its approaches we must have an adequate navy, to maintain the efficiency of the navy we must have a chain of large and thoroughly equipped naval stations extending from Key West to the Anegada passage.

An exceedingly interesting discussion of this general subject was given in a lecture by Capt. William V. Judson, U. S. A., at a recent meeting of the American Society of Political and Social Sciences in Philadelphia. Captain Judson holds that prior to 1898 we were the strongest of all nations on the defensive, but that in the acquisition of

possessions beyond the sea we have in a great measure lost our splendid defensive strength, although at the same time adding to our power to strike an enemy. "In war with a great commercial power," says Captain Judson, "equal or inferior to us in naval strength, we should probably find our acquisitions a distinct gain. But in war with a power of considerably greater naval strength we should find that we had but acquired points vulnerable to attack, and the questions of 'imperialism vs. anti-imperialism' and 'What shall we do with the Philippines?' would be speedily solved by our opponent."

Captain Judson submits three propositions, as follows: First, that a nation of any considerable size and military spirit, compact as to its territorial possessions, even if without a navy, is practically unconquerable if it possesses the advantages of remoteness from its enemy's primary base. Second, that a nation possessed of the predominant sea power may add to its isolated colonial possessions *ad libitum*. With its fleets "in being" it is almost, if not quite, as easy to protect one hundred as ten outlying possessions, or, if not to protect them during all phases of a war, at least to end the war with its original possessions. Third, outlying possessions of any nation are in time of war at the mercy of an adversary possessing decided control of the sea.

From these premises the Captain draws the sound conclusion that if we would surely profit by our distant possessions and hold them in safety we must build and maintain a navy equal to any in the world but Great Britain's. He feels that our friendly relations with the British are secure. Granted that a powerful navy is necessary, he points out that naval stations are absolutely indispensable. A war fleet, like an army, must keep its lines of communication open. We take it as an auspicious circumstance that experienced and far-sighted engineer officers of the army like Captain Judson are manifesting an increasing interest in the naval arm of our national defenses. It is upon the hearty, intelligent co-operation of the trained leaders of both services that we must depend for the continued security of our expanding interests on land and sea.—*Army and Navy Journal*, April 19, 1902.

BLACKWELL'S ISLAND.—It is probable that the Navy Department will secure possession of Blackwell's Island. A bill has been introduced in the New York State Legislature providing that Blackwell's Island shall be leased to the National Government for 50 years; the condition is that the National Government agree to establish a naval station on the island, and that it be made a naval park, embellished and beautified as such, and be kept open to the public. The Navy Department is strongly in favor of this measure, and it is quite probable that this most beautiful park, in the very center of New York City, will soon cease to be used as the dumping ground of gutter criminals.

TRAINING OF LANDSMEN.—The Navy Department will adopt a new method for the training of landsmen for the service which, it is believed, will tend to increase the efficiency of the navy and prevent the entrance in the service of many men who are not qualified. In the future all green landsmen will first be given a preliminary course of training of six months' duration on land, at the end of which there will be a weeding-out process, and only the men who have shown ability will be sent to sea on training ships. The land training of the men will be conducted at

Port Royal, S. C., at New London, Conn., and later at Norfolk, Va. The training ships Franklin and Richmond are to be provided with accommodations for one thousand men. This scheme is the first step towards the final adoption of Read-Admiral Crowninshield's long-advocated plan of having seamen trained at land barracks and entirely doing away with the training-ship system.—*Army and Navy Journal*, April 5, 1902.

S. O. 22, May 2, Navy Department.

The recent accident on board the British battleship Mars on April 14, whereby two officers and nine of the crew were killed and seven men were wounded, due to the unlocking of the breech plug of a 12-inch turret gun after a hang-fire, was of such an appalling character that it seems proper to call the attention of the service to the necessity of exercising the utmost caution and prudence in all cases where a hang-fire takes place, in order that the possibility of an accident due to such a cause will be reduced to a minimum.

While it is not practicable to prescribe a definite length of time which should elapse before the breech of a gun can be safely opened after a hang-fire, no risk should be incurred in time of peace.

WILLIAM H. MOODY, Secretary.

MINNEAPOLIS.—The Navy Department has decided to install the protected cruiser Minneapolis as temporary receiving ship at the League Island Navy Yard, to relieve the old steam corvette Richmond, which is obsolete for the purpose and is to be towed down to the Norfolk Navy Yard. The Minneapolis will be placed in good condition, and is to be held ready for sea service at short notice in case of necessity. It is the opinion of the Secretary of the Navy that a ship will deteriorate much faster lying idle than when in commission for service, regardless of what that service may be. It is not unlikely that this idea will be applied to several other of the vessels in "ordinary" or laid up at the various naval stations in a state of almost complete unreadiness for sea service.—*Army and Navy Journal*, April 5, 1902.

BALTIMORE—NEWARK.—Extensive repairs are to be made on the cruisers Baltimore and Newark, and it is said that when they are again placed in commission they will be superior in battery and steaming radius to any other vessels of their type in the navy. The Newark is being overhauled at the Boston Navy Yard. Her twelve 30-caliber 6-inch guns on gravity return carriages will be replaced by new 6-inch 40-caliber guns on pedestal mounts. The old battery of the Baltimore of 6-inch and 8-inch guns will be removed and a new battery of twelve 6-inch guns supplied.—*Army and Navy Journal*, May 3, 1902.

NEW JERSEY.—The great stem plate for the battleship New Jersey, which is building at the Fore River Ship & Engine Co.'s yard, Quincy, Mass., has just been cast. It contains thirty-six tons of steel, and had to be left in the mould several days before it was cool enough to be uncovered. The casting, large as it is, is not the whole of the stem, but will serve as a foundation to which the keel, the hull plates and the upper part of the stem will be fastened. Just now the New Jersey's steel floor plates are being fashioned, and punches, shears, rolls, and joggling machines, all operated by electricity are kept at work on them continually,

while the frames for the battleship—which is to be one of the largest and most powerful vessels in the navies of the world—are being bent on a great iron scrive board. There are 3500 tons or more of material for the New Jersey on hand at Fore River now, and as quickly as each individual piece is finished it is carefully marked and set aside in its proper place, ready for immediate use when the construction of the ship has reached the point where it is required.—*Nautical Gazette*, March 3, 1902.

PERRY.—The torpedo-boat destroyer Perry was given a trial late in April, for speed over a measured mile in San Francisco Bay, the Bluff Point course, and reached a record of 27.1 knots. She is a sister of the Paul Jones and the Preble, and they were originally required to make twenty-nine knots. This was afterward modified to twenty-six knots for one hour, after making a maximum over a measured mile course in standardizing the screws.

BARRY.—On March 22, the torpedo-boat destroyer Barry was launched at Philadelphia. The Barry, which is the last of the three swift torpedo-boat destroyers built by Neafie & Levy for the government, is 245 feet long by 23 feet beam. She will have 450 tons displacement, 30 tons more than the original contract called for. The speed originally contracted for was 29 knots, but on account of the increased displacement it will be 28 knots. The engines are four-cylinder triple-expansion of 8000 estimated—8500 actual—horsepower. She will carry five 6-pounder and two 12-pounder rapid-firing rifles.

ADDER.—The submarine boat, the Adder, made her first trip in fresh water on the Potomac on Monday, May 19. Accompanied by the steam yacht, the Mindora, she left the navy yard, Washington, to a point opposite Mount Vernon and under her own power. The trip of about eighteen miles consumed two hours. She was then trimmed and went over a short course, both upon the surface and submerged. The longest of the trips of the latter type was a mile and a half, and the Adder made several porpoise dives, acting very well under all of the tests.

PREBLE.—The torpedo-boat destroyer Preble, launched at the Union Iron Works on March 2, 1901, and found lacking in speed, has been taken on a preliminary spin around the bay, alterations in her model having been made. Forced draught was not used, but a speed of 27 knots was maintained over the measured mile, which was covered 12 times, and 24 knots an hour was recorded on the return trip. With forced draught it is claimed that there will be no trouble in making 30 knots an hour, the contract speed.

TURKEY.

The reconstruction of the battleship Messoudich, described in PROCEEDINGS No. 100, page 776, has been completed, and the new Messoudich has had her trials. The performance of the machinery was very satisfactory, the speed developed being seventeen and a half miles an hour. At the same yard where this reconstruction was effected, in Genoa, two sea-going torpedo boats have been built, which upon trial in a rough sea maintained a speed of 26 knots for seven miles, but these boats have not been delivered to Turkey because of the latter's delay in payment of the last installment of the purchase money.

AMMUNITION.

THE COST OF AMMUNITION.—Rear-Admiral O'Neil, Chief of the Bureau of Ordnance, U. S. A., has made an investigation into the cost of the war with Spain, showing the cost of ammunition expended at the decisive naval battles of Manila and Santiago. In the fight with Montojo's fleet at Manila the details of fire were as follows:

Name of Vessel.	Total Rounds.	BATTERIES.		Cost.	Weight of Metal in Tons.
		Main.	Secondary.		
Baltimore	1434	195	1239	$10,934.71	15.4
Olympia	1677	317	1360	10,605.35	13.1
Boston	1106	210	896	9,778.26	13.7
Raleigh	591	294	297	8,026.64	10.2
Concord	582	182	400	6,466.46	8.9
Petrol	428	115	313	4,235.95	5.6
Totals	5818	1313	4505	$50,047.37	66.9

The expenditure of ammunition at Santiago was as follows:

Name of Vessel.	Total Rounds.	BATTERIES.		Cost.	Weight of Metal in Tons.
		Main.	Secondary.		
Brooklyn	1973	573	1400	$18,640.15	25.1
Oregon	1903	198	1705	24,960.13	36.6
Iowa	1473	317	1156	15,820.00	21.8
Indiana	1876	107	1769	14,826.59	19.5
Texas	835	105	730	6,405.61	8.6
Gloucester	1369	...	1369	3,658.10	2.6
Vixen	45	...	45	97.20	.1
Totals	9474	1300	8174	$79,407.76	114.3

At Santiago, out of the total fire only 124 rounds, or 13 per cent, are known to have hit their marks; the Oquendo was struck 61 times, the Viscaya 28 times, the Maria Teresa 29 times, and the Colon 6 times.

ARMOR.

THE MANUFACTURE OF ARMOR PLATE.—The manufacture of armor plate for vessels of war is much more complicated than it used to be, and comprises a certain number of successive operations. The first is that of casting the ingot which is to be transformed into an armor plate. The ingot, which weighs from 70 to 80 tons, is carried to the room containing the presses and put into the reheating furnace in order to be raised to a temperature that will permit of its form being changed. The time necessary to effect such heating is, for large ingots, from 18 to 24 hours. The ingot is carried by a 150-ton traveling crane to the hydraulic press designed to flatten it. The large presses are huge affairs, weighing 800 tons, and of 8000 horsepower. They consist of two hydraulic cylinders 3.28 feet in diameter with a 10-foot stroke. They are supported by cast

steel cross pieces held by four forged steel columns. Such a system is sufficient for exerting a pressure of 7150 pounds to the square inch, although in practice scarcely 5700 pounds are exceeded. The press is actuated by steam pumps. The levers that control the press, those of the traveling cranes that support the ingot and those for driving the different tools are placed side by side. The work can thus be performed with truly extraordinary facility. The apparatus through which the ingot is suspended is so arranged as to permit the latter to be turned over so that the two faces can be flattened in succession. With the enormous power of the hydraulic press, an ingot 4.25 feet in diameter is converted into a plate 14 inches in thickness and its length increased from 6 to 21 feet in about an hour. When the plate is to pass to the rolling mill, a length of the proper thickness is produced and its end clipped off. The plate rolling mill is a massive machine provided with two forged steel cylinders nearly 3 feet in diameter, 12 in length, and each weighing twenty tons. A steam engine actuates them at a pressure of 72 pounds to the square inch. The mill is accompanied with a traveling crane capable of lifting 60 tons. The feed rollers extend to within 42 feet of the compressing cylinders. The mill is capable of reducing a 30-inch plate to 6 inches at a single heating. The press and mill are thus capable of working four large plates a day. Upon its exit from the rolling mill the plate is cooled, and specimens are then taken from it in order to ascertain the tenacity or other properties of the metal.

The next operation is case hardening. This consists in heating two plates separated by a layer of charcoal and enveloped with bricks and sand. This system is placed in a gas furnace and submitted to a high temperature for fifteen days, at the end of which the surfaces in contact with the charcoal have had the time necessary to become sufficiently carbureted. Immediately after carburetion, the bending is done. The plate is reheated and the curvature desired is given in the large press. The plate is placed upon a wide anvil, and a matrix is made to exert its powerful action upon the upper face.

After the bending has been effected, the plate is carried to the planing room, where the final dimensions that it is to have are given to it. The planing machines employed are huge affairs. Their bed weighs 30 tons, and, as the plate weighs just as much, sixty tons are thus set in alternate motion. There are, moreover, several kinds of these machine tools, including special ones for planing the edges of the plate.

Afterward comes the operation of boring designed to perforate the plate with the holes necessary for fixing it to the hull of the ship. The holes are bored by means of small portable machines actuated through a cable or an electric motor. They are afterward reamed out. Care is taken to plug them with clay in order that they may not be injured by the subsequent operation of tempering.

The tempering requires that the plate shall be first heated to the necessary temperature. This operation is performed in a furnace analogous to those already mentioned. The plate, heated to the degree desired, is put upon an iron grate, and a sprinkling apparatus wets both of its faces. The pressure of the water is such as to prevent the formation of steam in contact with the plate, which would retard the effect of the tempering. The sprinkling lasts three hours, and, during this time, no less than four or five tons of water fall upon the plate. The hardening thus produced reaches a depth of from 1 to 1½ inches.

Finally, the last operation consists in the grinding designed to give the plate its finish. The grinders are fixed upon a cast-iron disk set in operation by a 30 H. P. electric motor furnishing 400 revolutions a minute. The apparatus is capable of assuming every possible inclination in order to attack all points of the plate.

Upon the whole, the various successive operations in the manufacture of a large armor plate are the following: Casting of the ingot; flattening in the hydraulic press, rolling; case hardening; bending; planing; boring; tempering, and grinding. (For the above particulars and the engraving we are indebted to *La Nature*.)—*Scientific American Supplement*, March 15, 1902.

ARMOR PLATE FOR THE RUSSIAN GOVERNMENT.—The construction of the battleship Retvizan and the cruiser Variag for the Russian government by the American shipbuilding yard, the armor for which ships was made by the Bethlehem Steel Company, has led to the placing of other Russian orders for plate in this country. A striking evidence of this was seen last week in a train of eighteen cars which left Homestead on express orders for New York, carrying thirty-six plates for the first-class battleships Borodino and Ariel, which are now building at the Imperial yards at St. Petersburg. The consignment represented six months' work at the armor-plate department at Homestead. In view of the fact that the armor plate required for the new warships for the United States navy is more than sufficient to keep the Bethlehem Steel Works and the Carnegie Works continuously occupied, it is evident that there is a call for other armor-plate factories in addition to the two above named. We understand from the last report of the Naval Bureau that a third firm will shortly be in a position to turn out Krupp armor; but if we are to furnish the armor for our own navy and also supply foreign governments on the scale of this recent shipment, it is evident that there will soon be a demand for a fourth armor-plate-making establishment. The industry is an extremely profitable one, even at the reduced price at which plate is now being furnished. Indeed, we do not know of any industrial enterprise in which capital could be invested on a large scale with a surer certainty of profitable returns. There is not the slightest indication of any slowing up in the rate of growth of the navies of the world, our own included; and if the United States navy is to increase in adequate proportion to the extension of our foreign trade (as it certainly should do), the demands of our navy alone will before long require double the amount of armor plate that is now being furnished annually by existing works.—*Scientific American*, March 29, 1902.

GIEBELER STEEL.—The publication of the tests made at Charlottenburg with the new steel invented by D. Giebeler, a Mecklenburg manufacturer, shows how exaggerated have been the reports circulated in the daily press both here and abroad. The tests have proved merely that Giebeler has invented a very dense steel which, however, is lacking in the most important property of ductility. It will be remembered that Giebeler steel was claimed to be far superior in hardness to Krupp, Böhler, and Harvey steel. It was furthermore claimed that in cost Giebeler steel was one-third to one-half cheaper than Krupp steel. But exactly what the price of Krupp steel is at the works no one but Krupp knows. For that reason it is difficult, indeed, to institute comparisons

so far as cost is concerned. In the Charlottenburg tests the tensile strength fluctuated from 86.6 to 163 kilogrammes. Are these results so very remarkable? Holtzer nickel-steel has a breaking strain per square millimeter of 161 kilogrammes; nickel-steel made by the Société Anonyme de Commentry-Fouchambault et Decazeville, a breaking strain of 153.1 kilogrammes. Moreover these specimens of steel had a ductility of 15 to 16 per cent. Results equal, if not better than these, have been obtained with the best Krupp and Harvey steel.—*Scientific American*, March 22, 1902.

One of the most important questions now before naval engineers, and one regarding which little has been published, relates to the probable indirect effect upon a warship by the repeated striking of 8-inch or larger projectiles upon the armor belt of the vessel. It is held by many of the most experienced officers connected with the Bureau of Steam Engineering of the Navy Department that this, at the present time, is of far more importance to the navy than the consideration of the other features of armor plate versus projectile. Up to the present it has been impossible to get a satisfactory shell which will pass through armor plate of the thickness used on modern vessels and explode on the other side. It is held, however, by many experienced officers that the shock of projectiles striking the side of a vessel, even if they do not penetrate the armor, may be sufficient to sink the ship or put it out of action, by throwing out of gear some of the hundreds of separate steam cylinders, scores of bearings of various sorts and thousands of bolts on which the efficiency of a modern vessel of war depends. There is no question but that the impact of a projectile upon the side of a ship will have an effect much beyond the damage done in the immediate vicinity of the point of impact, as is shown by the common phenomenon of an object falling in one room as the result of a blow struck in another room. This important matter is receiving the closest attention from our naval experts at the Navy Department and is giving the naval engineers more concern than the consideration of the direct damage that would be inflicted by shells. Armor is now of such strength that it can withstand projectiles fired from any gun, but what will be the extent of the indirect damage inflicted by such shells? This is a question to be determined.—*Army and Navy Journal*, Feb. 8, 1902.

In expressing his views regarding new vessels for the navy the United States Board of Naval Construction, in a recently submitted report, places itself on record against sheathing the bottoms of ships, favors Krupp armor, and advocates the instalment of guns not heavier than 12-inch caliber. In the opinion of the board the advantages resulting from sheathing are more than offset by the disadvantages. It admits that sheathing and coppering are a partial protection against fouling, but believes that under ordinary conditions the bottoms of vessels can be kept clean by the use of anti-corrosive and anti-fouling paints. Concerning armor, the board says that both battleships and armored cruisers should carry as much armored protection as is practicable without detriment to their other important features. Eleven inches is the maximum thickness of the armor of the best quality considered necessary or desirable for battleships, and for armored cruisers 6 inches for the heavy part of the main belt, 8 inches for the turrets and barbettes, and 9 inches

for turret port plates. The elliptical balanced turret, with inclined port plates, is considered the best.

A NEW KRUPP ARMOR.—Our readers may recollect a recent letter from Herr Krupp commenting on some remarks of ours concerning the peculiar turret bases of German armored cruisers. As we pointed out at the time, the shape of these bases—an inverted cone—was ideal as against gun fire, but an apparently impossible shape for construction by any known method with Krupp-cemented armor. For all curved surfaces, indeed, non-cemented Krupp is employed, with a corresponding loss of resisting efficiency. Herr Krupp's letter, it will be remembered, claimed that the problem had been solved. No details were entered into, and comment was therefore impossible.

We are now in a position to supply a few meager details of an entirely new armor process, which on trial has given a figure of merit as high as 2.8 without the limits of resistance being reached. The figure of merit of the best cemented Krupp vertical plates varies from 2.7 to 3.1 or so —3 being the generally accepted average. The variety that exists is due chiefly to the relative inexperience of some manufacturers and the fact that the lower efficiency plates were maiden efforts or nearly so.

Few, if any, of Krupp's own plates have been tested beyond the resisting limit. Some figures of recent trials with cemented armor plates may be of interest, and they will serve to indicate how far tests have been carried against them.

Plate. In.	Highest penetration of shot against iron.	Minimum figure of merit.
5.5	15.7	2.85
4.5	11.4	2.53
11.8	33.6	2.85

These figures are from acceptance trials for plates for recent ships, and do not therefore imply anything beyond the fact that they were, at least, as good as the minimum given. The projectiles were broken, and the backs of the plates unhurt. Any of these, then, may be safely assumed at 3 as a figure of merit, the odds being rather that they would have exceeded that than otherwise. However, all this is by the way.

The new armor is claimed by Herr Krupp to be "hardly inferior" to cemented plate. Doubtless this claim is based upon comparative trials of the limits of resistance which are not public property. For that matter, nothing at all about the new armor has been public property for more than a few days—the plate exhibited by Herr Krupp at the Düsseldorf Exhibition—opened on the first of the present month—being the first "publication" of the matter, and this, we believe, the first reference to the matter in the British press.

The process is not, however, of immediate moment, the points of salient importance are that the armor is, for the most practical purposes, equal to the best cemented; and (2) that it is believed to be applicable to any form or shape that may be required. Round turret cupolas have already been constructed of it, and are known to have undergone severe tests at Meppen—Herr Krupp's proving ground.

On April 2d last a "casemate" plate of this cast cemented armor was fired at at Meppen. The results were as follows:

SIZE OF PLATE, 8⅝ FEET BY 6⅛ FEET BY 6 INCHES.

Shot.	Caliber of attack.	Weight of projectile, forged steel A. P. shell.	Striking velocity, foot seconds.	Effect on projectile.	Effect on plate.
	Inches.	Pounds.			
I	6	112⅛	1762	Broken up.	No damage. 1.4 in. indentation.
II	6	"	1795	"	No damage. 2 in. indentation.
III	6	"	1840	"	No damage. 2.3 in. indentation.
IV	6	"	1860	"	Not penetrated.
V	6	"	1896	"	Not penetrated.

Shots II, III, and V indicate their presence on the back of the plate, which, it will be noted, has behaved much as an ordinary cemented plate—exhibiting, if anything, less tendency to crack under projectiles that nearly penetrated. Shot V, with 1896 foot-seconds striking velocity, had a calculated penetration of 15-inch iron—the figure of merit of over 2.5 is established by this hit. Other trials, as we have stated, have shown a figure of merit of over 2.8.

The new armor exhibits great toughness combined with a very hard face. In addition to other tests it has stood that of a 10-inch shell loaded with nearly 65 pounds of high explosive—picric acid, which is about equivalent to lyddite. An 8-inch cupola went through this test unharmed, and is now on exhibition at Düsseldorf.—*The Engineer*, May 16, 1902.

BOATS.

SUBMARINE TORPEDO BOAT.

THE MORIARITY SUBMARINE.—The torpedo boat according to this invention is intended to be operated within a small radius by a single navigator. It is largely of submarine type, and carries a Whitehead torpedo beneath it in an open cage, having attached apparatus for starting the torpedo and liberating the vane of the warhead, these operations being performed simultaneously when the torpedo is to be fired as a missile, or the starting operation only when the torpedo motor is to be used to assist the boat in escaping from an enemy. The boat is propelled by a gasoline motor, compressed gases serving for performing many of the necessary control operations. (Accepted March 26, 1902.)

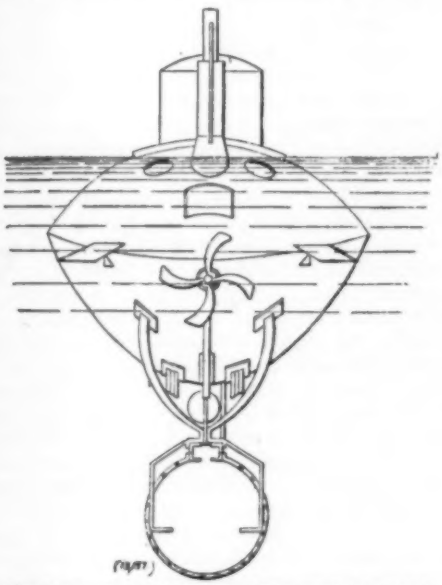
THE HOLLAND BOAT EXPLOSION.—In answer to a request from the Navy Department, the Holland Boat Company, by E. B. Frost, secretary, has presented a report upon the causes of the explosion on the Fulton while inside Delaware Breakwater on April 29. After detailing the circumstances of the voyage and the explosion this report says:

"We have made a very careful examination as to the cause and method of generation of gas, conferring for this purpose with the four

highest authorities, so far as we know, on the subject of electric storage batteries, with the following result:

"The accident was undoubtedly due to the collection of an explosive mixture of hydrogen and air over the top of the battery and under the battery deck, ignited by a spark caused by a ground.

"The presence of the hydrogen was due to the following circumstances: Some time prior to the trip the Fulton was accidentally sunk at her dock and filled with salt water. This salt water penetrated the large battery tank that holds the cells, and impregnated the insulation which separates the cells from the containing tank. This established a bad ground on two cells as was proven by actual test. The grounding of the two cells established a circuit from the positive plate in one of



The Moriarity Submarine. (See opposite page.)

the grounded cells to the lead lining of the tank, liberating oxygen at the lining; this circuit was completed through the ground and lead lining to the negative plate of the other cell, liberating hydrogen at the lining.

"As the battery tanks had been thoroughly ventilated after charging on Sunday, the 27th, this action had been going on for something less than two days. As the battery deck is practically tight and the ventilator had not been run during this period, no escape was provided for the gas. When the proportions of oxygen and hydrogen were such as to make the mixture explosive, a spark due to the ground completed the conditions necessary for an explosion.

"In arriving at this conclusion as to the method of the generation of this gas all other possible means of such generation have been considered.

"As is well known, electric storage batteries, during the process of charging, give off large quantities of hydrogen. This condition is

handled in the Fulton and in government vessels by the installation of special blowers, which are always running during the process of charging and for sometime thereafter, thus insuring proper ventilation of the tanks and preventing the accumulation of any hydrogen underneath the battery deck.

"During the process of discharge, the battery gives off practically no hydrogen, probably not enough to cause an explosive mixture even in the confined space of the battery tanks, *certainly* not enough during the complete discharge of the battery to cause an explosive mixture in the main body of the boat. It is also true that were the battery to be completely discharged through grounds, as above described, the amount of hydrogen generated would not be sufficient to make an explosive mixture in the main body of the boat.

"It is obvious then that if hydrogen formed from either cause is passed into the main body of the boat an explosion would be impossible.

"As stated above, the battery tanks of the Fulton and the boats building for the government are provided with a special ventilating blower which, when running, insures a circulation of air through the battery tanks. Therefore, in order to prevent a recurrence of this accident it is only necessary to run the blower as at present installed at frequent intervals, or to so modify the blower connections as to enable it to be run continuously at a lower speed.

"It appears then that it is entirely unnecessary to make any modification in the boat itself, as all that will be required is the proper use of the apparatus now installed.

"We will be pleased to prepare a memorandum covering the subject of instructions as to the proper ventilation of the batteries for the use of the commanding officers of the government boats.

"In conclusion, we desire to point out to the Department that unquestionably the importance of this accident has been unduly exaggerated by the public press and common report on account of the widespread popular interest concerning the subject of submarine navigation.

"In the connection, we desire to point out that from March, 1898, until July, 1900, the Holland, which was then under our control, was almost continuously in commission and made over 500 dives. No explosive accident of any sort or nature ever took place during this time, nor was any difficulty ever encountered through the leakage of gasoline. The only accident suffered by the vessel occurred while she was running on the surface under her gasoline engine and was due entirely to a leak in the engine exhaust, which permitted the escape of the products of combustion of the engine into the interior of the boat. The only result of that accident was the overcoming of a portion of the crew through inhalation of the products of combustion.

"With proper original workmanship and care a recurrence of that accident is impossible.

"The Holland has been under the control of the government since June, 1900, and has, we believe, been continuously in commission. The number of dives made while under government control is probably largely in excess of the number made before she was turned over. We have yet to hear of any serious accident or trouble with her since she was turned over.

"The Fulton has been in commission since October, 1901, and has made over 200 dives. The accident discussed above has been the only

one suffered by her with the exception of the sinking at the dock. That was due to gross carelessness and was in no way connected with the special features of the design, so that it might just as well have happened to an ordinary surface boat.

"The record of these boats speaks for itself when compared with the records of ordinary surface navigation."

TORPEDO-BOAT DESTROYERS,* by S. W. Barnaby.—So much attention has been drawn to the destroyer class of the British navy during the past year, that no excuse is needed for a short paper on the subject.

It will necessarily be short, because no full treatment of the question is possible, in view of the fact that a committee is now sitting at the Admiralty, and is investigating all the cases in which defects due to weakness of construction are reported to have developed during service at sea. I shall not therefore attempt to discuss these cases, because the facts have not been authoritatively made known. Neither do I wish to express an opinion as to the loss of the Cobra. I will only say that, although she was an exceptional and experimental vessel, still, if we are to believe that no injury to the bottom preceded the accident, it must be considered surprising that no preliminary straining or laboring of the joints gave warning of danger. We have no experience of mild steel, of the high quality to which we have become accustomed, having failed suddenly, even under repeated applications of stresses well within the elastic limit of the material; but as to what really happened, the evidence, to my mind, is not at all conclusive.

The problem which was originally set the destroyer builders was, to produce a small vessel which would be faster than a torpedo boat, and would carry a heavier armament. These were the sole conditions imposed. Messrs. Yarrow and ourselves, who made the first designs, naturally worked on the lines of the torpedo boats which we had been building for years. Speaking for ourselves, we had confidence, from our experience with these boats, that if destroyers were developed on the same lines they would be at least as seaworthy as torpedo boats, if not more so. We had built over 200, some of which had made voyages in all weathers and to all parts of the world, and not one had been lost at sea through insufficient strength. We considered that they must be amply strong to live through any weather in which they might be caught, but that the officers and men might reasonably be asked to submit to the same amount of discomfort at sea as was borne by the crews of torpedo boats, seeing that they were designed for the special purpose of catching these boats.

The torpedo gunboat of 800 or 1000 tons is probably the smallest vessel in which any degree of comfort for the crew can be secured when it is necessary to remain constantly at sea; but although the torpedo gunboats may be able to overhaul torpedo boats in rough weather because of their size, a class was wanted which would overtake them in any weather, and I think this want has been met by the present destroyers. So far as I know, this condition of discomfort has been cheerfully accepted by the navy, and the important question is, can these small vessels of high speed be made reasonably safe at sea? I think there is no doubt that they can.

*Paper read before the Institution of Naval Architects.

The strains coming upon a ship among waves are not exactly, or even approximately, calculable. The effect of the inertia forces produced by the rapid motion of the ends of the vessel as she pitches and scends cannot be estimated, because the velocity of the motion of the parts is not determinable. It is not necessary to enumerate the complex forces produced by the motion in a seaway; it is sufficiently evident that the data for exact calculation are altogether wanting. Then, again, while at one moment the deck of the vessel forms the top of the girder and the keel the bottom, at the next moment the rolling of the vessel may make the corner of the deck take the place of the top, and the opposite bilge that of the bottom of the girder.

All that it is possible to do is to establish a scale of comparison by which we may judge of the safety of one vessel by comparing her with another which has shown no sign of distress during the time that she has been at sea, and even then it is always possible that exceptional circumstances may occur which may cause us to modify from time to time our standard of comparison.

It is usual to suppose that by considering the vessel first as poised upon the summit of a wave of her own length, and then as lying between the crests of a pair of such waves, and reducing the hull to the form of an equivalent girder, that a method of comparing the stresses to which ships are subjected at sea is possible.

The vessel may never be in such a condition, probably never is, and if she were, the stresses would doubtless be different from what they are calculated to be; but in default of a better way of ascertaining if a given ship stands at least as good a chance of safety at sea as some other ship which has proved to be satisfactory, the test is a valuable one. It is usual to assume the height of the wave for vessels of this size as about one-twentieth of the length, and some idea of the severity of the supposed conditions may be obtained when it is stated that it means that a 210-foot destroyer is immersed to the gunwale at the two ends, and that only about 2¾ feet of the depth of the hull amidships is in the water when she is lying in the trough; and that when poised on the crest, about 34 feet of each extremity of the ship is out of the water altogether.

It is, of course, of great importance that the deck should not only be sufficiently strong to avoid buckling locally under compressive strains, but that the form of the deck, as a whole, should be rigidly maintained. In the long machinery compartments, where there are no bulkheads, either transverse or longitudinal, great care needs to be taken that the deck beams and longitudinal deck girders are sufficiently strong for the purpose. In some of the latest destroyers built abroad, where the engines are placed between the boilers, the coal-bunker bulkheads are continuous through the engine-room, and greatly add to the strength amidships, but this arrangement obliges the engines to be placed one in front of the other, since there is not sufficient width for them to be abreast. This so greatly adds to the length of the ship, and consequently to the bending moment, that it is, to my mind, a doubtful advantage. The longitudinals and deep beams over these spaces will no doubt be reinforced in boats in which any tendency to bending has been observed. I think that they might with advantage be further supported by pillars, in order to strengthen the deck to withstand the compression to which it is subjected under a sagging moment.

Our practice has been to make the deck perfectly straight for the greater part of the length of the ship, giving no sheer except at the bow. Any sheer amidships prevents the deck from taking its proper share of the tension coming upon the upper works under hogging moments, and throws undue stress upon the sheer-strake.

One of the most important factors determining the strength or weakness of a destroyer—more important, in my opinion, than the thickness of the plating—is the ratio of depth to length.

In the Albatross, which is the longest we have built, there are 15¼ depths in the length; but in some of the class, I believe, the depth is much less in proportion. Two destroyers may have the same scantlings of plates and frames, and be alike in length and displacement, and yet one may be a weak ship and the other a perfectly sound one; and especially may this be true if there is a great disproportion in relative depth.

As regards details, to which we attach great importance, I will only mention one or two. Unless the greatest care is taken in levelling the shell and deck plating by hand upon the slab, parts of the plate will be more severely strained than other parts, and the strength of the whole plate will thereby be reduced; but this is an operation requiring great skill and taking much time. No amount of machine rolling will level these plates as they require to be levelled, if the full advantage is to be taken of every pound of the material.

Joggling the butts of deck plating is, in my opinion, an undesirable practice, especially when this is of high tensile steel. I think it not only injures the plates to treat them in this way, but it also prevents the full tensile strength of the plate from coming into play. A joggled stringer butt, for instance, is subjected to an unfair pull, which has to straighten the kink in the plate before it can stretch it, and an excessive strain is thrown on the sheer-strake.

The riveting is another detail requiring the greatest care, and we never allow this to be done by piece-work. The introduction of high tensile steel has made the question of riveting of still greater importance. The value of this material would be much enhanced if rivets of the same strength could be employed; but there are difficulties attending its use, and not much experience has been gained with hard steel rivets up to the present.

If rivets, either of mild or hard steel, are riveted cold, they appear to become brittle and treacherous, and our experience has satisfied us that good Lowmoor or charcoal iron rivets are more reliable, and as strong as steel rivets when put in cold. Rivets of small diameter cannot, we believe, be safely put in hot, whether they are iron or steel, because they are liable to waste by scaling in heating, and are cooled so rapidly on being put into the holes that there is not time to properly knock them up before they arrive at a temperature at which hammering is injurious to steel. We therefore prefer iron rivets for sizes up to ⅜ inch or 7/16 inch, but those of ½ inch or upwards might be of steel, and should be worked hot. It may be possible to use high-tensile steel for these, if it is certain that its quality is not affected by the heating, on which point more experiments are desirable. The spacing of these rivets could be greater than with iron rivets, and the plate would be stronger at the joint.

The ratio of weight of structural hull to total displacement in destroy-

ers is not unduly light, and does not compare unfavorably with that found in other classes of warships. For example, Sir William White, in his "Manual of Naval Architecture," gives the weight of material contributing to structural strength in a steel-built first-class battleship of the present day as 18 per cent of the total displacement, and for a typical swift protected cruiser of high speed, large coal supply, and heavily armed, as 20½ per cent of the total displacement. This is considerably less than the percentage of weight of material contributing to structural strength in torpedo boats and torpedo-boat destroyers.

Although the Thornycroft destroyers are not longer in proportion to depth than the earlier torpedo boats, we have taken more care to preserve the continuity of longitudinal strength than was done in those boats. Continuous keelsons, side stringers, and deck stringers have been introduced which were not fitted in the torpedo boats, and far more attention is now paid to the fitting of doubling plates in way of openings in the deck, such as funnels, fan cowls, hatchways, etc., in order to compensate for the material cut away by these openings, and thus to bring the strength there up to that of a normal section taken through the rivet-holes at a frame, which should be the weakest section in the ship. To this question of compensation the Admiralty have very properly attached great importance in all their recent specifications, and there is no doubt that it is much more necessary to pay careful attention to it than it was in torpedo boats, on account of the increase in dimensions.

The longitudinal bending moments for similar ships on similar waves vary as the fourth power of the linear dimensions, so that the stress per square inch of material will increase with increase of dimensions if weight of hull vary as displacement, and as a rule this is found to be the case. Large ships are usually more highly stressed than small ones. M. Normand and others have shown that structural weights should vary as the four-thirds power of the displacement for equal stresses under longitudinal bending in similar vessels. But in dealing with moderate increases of dimensions, as in passing from a torpedo boat to a destroyer, there are a good many of the scantlings, such as plating over propellers, doublings and chafing-plates in way of anchors, coal-bunker bulkheads and shovelling flats, and other parts which do not count for much in structural strength, but which require to be of a certain minimum thickness for local strength in the smaller vessel, and which do not need to be increased in the same proportion as the rest. The weight thus economized can be utilized in thickening the deck, keel, and sheer-strake amidships above their proper proportion, and thus the stresses per square inch of material do not rise at the rate that they would otherwise do. As a matter of fact, we have found that by improvements in structural detail, such as I have mentioned, it has been possible to keep the estimated stresses in a seaway down to a figure which allows a good factor of safety, taking into consideration the strength of the high tensile steel employed.

There is no reason why boats having speeds of 30 or 31 knots at light draught should not be as capable of living through bad weather as a torpedo boat. This was the original standard; and provided that they are equally well proportioned and equally well built, they should run no greater risks than their prototypes did. If a higher standard of strength than this is now considered desirable for destroyers for the British navy,

so that instead of working from a base they may always accompany the fleet at sea, I believe this requirement can be met without a great sacrifice of speed.

It would be unfortunate if the exaggerated impression which has got abroad as to the frailty of destroyers as a class should lead to a swing of the pendulum in the direction of increase of weight which should greatly exceed the necessities of the case. If we go to such heavy scantlings, or if we so increase the dimensions in order to secure comfort at sea, that destroyers can no longer be fast enough to overtake torpedo boats in smooth water, would not their usefulness be much impaired? Other nations will probably continue to build small fast craft of this description, in which comfort is sacrificed to speed and efficiency, and can we afford to be left behind?

The present destroyers, like the torpedo boats, are lightly built at the ends, and it is necessary to give special attention to the bow plating and framing in new boats, so that they may be able to maintain speed in rough water. Besides the local strengthening of the bows and a moderate increase of scantlings generally—say from 10 to 15 per cent—to enable them to stand more knocking about, I think it would be wise to increase the ratio of depth to length even above that of the Albatross. The strength should then be ample for all requirements.

I do not feel at liberty to say anything about the latest designs that have been called for by the Admiralty, in which builders have been left, as usual, a fairly free hand. The moderate speed specified, 25½ knots, is due chiefly to the conditions of trial, which has now to be made with full load on board, and not, as previously, with a very light load. Although I should have preferred to see the trial made under average conditions of load—that is, in fully equipped condition, but with bunkers half full, rather than in either of the extremes of loading, still I can see no reason why thoroughly good boats should not be built under the new conditions laid down, provided that moderate views are allowed to prevail as to the hull weights and dimensions which are left to the judgment of the designer.

They will not be as fast at a light draught of water as the present boats are in that condition, but their speed will be increasing all the time as the coal burns out, and the average speed should be considerably more than that obtained on trial.

In view of recent events, what is a safe stress upon the material either of the deck in compression or upon the keel in tension?

Do our views upon the subject require modification, and, if so, to what extent?

Fairbairn found, many years ago, that the joints of an iron-riveted girder sustained upwards of three million changes of one-fourth the weight that would break it without any apparent injury to its powers of ultimate resistance. It broke, however, with 313,000 additional changes when loaded with one-third the breaking weight, evidently showing, he says, that "the construction is not safe when tested with alternate changes of a load equivalent to one-third the weight that would break it." There are numbers of large ships at sea in which the stresses must be considered very high if judged by this standard, but which have shown no signs of distress. This would seem to indicate that the extreme conditions assumed in the stress calculations are very rarely met

with, and that if they do occur, they last for a comparatively short time. But we have to remember that it is more difficult to get a thin plate to stand a compressive strain than a thick one, and also that small vessels are likely to encounter waves which will strain them more frequently than large ones. The waves which are assumed in stress calculations of battleships are given by Sir William White as 383 feet in length, and 24 feet in height; while those assumed for a 210-foot destroyer are 10½ feet only. Of course, the destroyer which has to keep company with a battleship may be called upon to encounter the 24-foot waves; but these, on account of their greater length, do not produce such a severe bending moment as the smaller wave. The boat cannot stretch from crest to crest, and is better supported than upon the shorter waves of less height. But, as I said before, these calculations cannot be depended upon for exact figures, and are only useful as methods of comparison.

I have my own opinion as to how high a stress it is safe to allow; but it would serve no useful purpose to attempt to fix a definite limit, where so much depends upon workmanship and other intermediate quantities. The builder's own experience should be his guide. If all vessels had to be built to the rules of insurance societies, there might be less risk, but there would certainly be less progress; and torpedo boats and destroyers could never have come into existence.

BOILERS.

BELLEVILLE BOILER TRIAL.—In the professional notes published in PROCEEDINGS No. 100 are given the details of the Hyacinth and Minerva boiler trials. One must be impressed by the magnificence of the efforts of the British government to ascertain which type of boiler is best adapted to navy needs. The British Admiralty has recently published an exhaustive report of these trials.

The claim was made that the Belleville boiler is better suited for the navy needs than the Scotch boiler:

1st. Because it is lighter and is competent to carry a higher pressure.

The advantage as to lightness was proved to be of no real value because what was here gained was lost because of the great quantity of fresh water to make up the loss in feed, that had to be carried. During the trials no advantage of any nature developed because of the greater steam pressure.

2d. That steam could be raised quicker, and, therefore, full power developed more quickly with the Belleville than with the Scotch boiler.

This was disproved. After lighting fires in the Belleville boilers it took 53 minutes before full-engine power was developed, while after lighting fires in the Scotch boiler it took 49 minutes to develop full-engine power.

3d. That the Belleville boiler is more economical in generating steam than the Scotch boiler. The reverse was proved to be true.

4th. That the Scotch boiler is more liable to break down than the Belleville boiler.

The reverse was proved to be true. This was the report of trials made in 1901.

In 1887 a board of U. S. Naval Engineers investigated the claims made for the Belleville boilers by a series of trials upon the Belleville

boilers of the yacht Shearwater. The following is an extract from the report of the Engineer in Chief to the Secretary of the Navy for the year 1887:

Report made to Engineer in Chief, Geo. W. Mellville, U. S. N., of a board of U. S. Naval Engineers on the Belleville boiler of the steam yacht Shearwater, at Wood's Holl, Mass., in Nov., 1887—Conclusion: It is to be regretted that there were no means of increasing the rate of combustion and production of steam by a powerful forced draught. Under the conditions of the trial, the evaporation and rate of combustion were not greater than in boilers in common use in the naval service. The boiler steamed full, was under easy control, and furnished comparatively dry steam. Its weight seems excessive for the quantity of dry steam furnished, but this is due largely to the heavy casing and brick works, which would be proportionately less for a number of boilers placed together. The advantage of accessibility of the parts for repairs may be perhaps offset by extra liability to derangement on account of the large number of joints required in the fire surface. During the trial, however, the joints were all perfectly tight, the boiler being new.

The following items are furnished by the London *Engineering:*

Messrs. Yarrow and Co. shipped yesterday three large Yarrow water-tube boilers for the Russian government, to be fitted on board the Oksan, which is being built at Kiel, to be used for the training of Russian navy stokers. This vessel is being fitted with four different types of water-tube boilers.

In order that the engine-room ratings at Devonport may be able to gain a general knowledge of water-tube boilers of various types, one of the old battleships is to be selected for instructional purposes. The vessel is to have a stokehold sufficiently large to accommodate one boiler each of the Yarrow, Dürr, Babcock and Wilcox, Belleville, and Nicklasse types.

The Special Boiler Committee have decided to repeat the programme and steam trials of the cruisers Hyacinth and Minerva, including the race to Gibraltar and back. Before this, however, the vessels are to be steamed over the deep-sea course off the Cornish coast, at speeds of 16 to 18 knots and at full natural-draught speed. After three runs over the course at each of these speeds the Minerva will go to Stokes Bay for a series of runs over the measured mile at 10, 13, 17, and 18 knots speed. She will commence her trials next week, but the Hyacinth will be delayed for a week or two, owing to defects which are being repaired at Devonport dockyard.

Hyacinth and Minerva Trials.—The extensive trials of the Minerva and Hyacinth to determine the relative value of Scotch and Belleville boilers, fully described in the professional notes of Proceedings No. 100, are still the subject of much comment in the engineering journals of Great Britain. It will be remembered that the Minerva is comparatively old, and is fitted with Scotch boilers, while the Hyacinth is of recent construction, and fitted with Belleville water-tube boilers. Commenting upon this subject, *The Marine Engineer* of April 1, 1902, says: "The report of the Boiler Committee on the trials of the Min-

erva and the Hyacinth cruisers and the mail steamer Saxonia is to hand. It brings very clearly to light the large loss of water that occurred with the Hyacinth's water-tube boilers and the 'bird nesting' defects which occurred to the cylindrical boilers. The latter defects, however, can be remedied, despite what has been said to the contrary. The committee compared the results obtained by the two cruisers, and come to the conclusion that at 2000 and at 5000 horsepower the Minerva's coal consumption per square foot of grate (with the number of boilers actually in use in each case) was somewhat less than that of the Hyacinth, but that, at higher powers, the larger grate area of the Hyacinth reversed this ratio, so that at 8000 horsepower the Minerva was burning 30.3 pounds per square foot, as against 19.8 on the Hyacinth, the latter ship only burning 27.2 pounds when indicating over 10,000 horsepower. The rate of transmission of heat through the heating surface varies similarly. In comparing the Saxonia with the cruisers, emphasis is laid on the fact that the machinery of a merchant steamer is designed to work most economically at one particular power, whereas the engines of the cruisers have to give reasonably economical results at any power varying from 25 per cent to 75 per cent of their full power. There is even, when this is considered, a remarkable difference in the results obtained in the cruisers and the Saxonia. The boiler efficiency of the latter, we read, reaches the exceptional figure of 82.3 per cent. The boilers are, of course, large for their work, the rate of combustion being 20.6 pounds per square foot of grate, and the heat transmission 5416 thermal units per square foot of heating surface. But this does not differ very much from the rate of transmission in the Minerva and Hyacinth at 2000 and at 5000 horsepower with the number of boilers actually in use on the trials, where the highest attained efficiencies were 71.8 and 77.2 per cent. The evaporation 'from and at' in the Saxonia is, of course, correspondingly high, being as much as 12.3 pounds of water per pound of coal.

"Dealing with the combined results of the engines and boilers the committee point out there was not the least difficulty in either ship in maintaining the power required on the full-power trials. In the Hyacinth were running for the higher powers, but no air-pressure was recorded in the stoke holes. The Minerva used closed stoke holes at 8000 horsepower and on the retarded trial. The Hyacinth ran for eight hours with an average power of 10,180 and the Minerva for nine hours with an average power of 8132. On the Gibraltar runs these results were fully confirmed. As to engines' economy comparing in the first instance the two cruisers only, it will be seen that at the two lowest powers that the Minerva uses considerably less steam per horsepower hour for all purposes than the Hyacinth. At 2000 horsepower the comparative figures are 18.2 and 18.8, and at 5000 horsepower 15.5 and 16.68. At 8000 horsepower the Hyacinth's engines use less steam than those of the Minerva, in the proportion of 16.88 to 18.866 (a difference of about 10.5 per cent), this being practically full power in the Minerva and about 82 per cent of full power in the Hyacinth. At 10,000 horsepower the Hyacinth (working with open exhaust) is again more economical than the Minerva at 8000 horsepower. The Saxonia's engine results are excellent, although not so striking as those of her boilers. The steam consumption of her main engines at about 9000 horsepower is practi-

cally the same as that of the main engines of the Minerva at her most economical power, viz., 13.47 pounds against 13.40. On the whole, therefore, it would appear that the engines of the Minerva type can practically be made as economical in working as first-class engines in merchant steamers. But in the latter case the most economical power is, naturally, full power, i. e., the power at which the engines are generally working. In the case of the cruiser, which has to work at very varying powers, the most economical point seems to be a little above half power. The difference between the Saxonia and the Minerva lies altogether in the boilers. Judging by the Hyacinth's figures these remarks do not, however, apply to naval engines of the short stroke and quick revolution type, even when working with a much higher pressure of steam."

COALING SHIP.

Terrible (cruiser, Capt. P. H. Scott, C. B.) has (according to a Hong Kong telegram) stowed 2500 tons of coal in nine hours and ten minutes. She averaged 300 tons an hour for 2450 tons, the maximum rate for one hour being 425 tons.

The Terrible's recent coaling record works out at just over 263 tons an hour. She took 2500 tons in 9½ hours, a larger quantity than has ever been handled before, and the enormous total makes the record even better than the figures look. The records now run: (1) Terrible, average 263 tons; (2) Prince George, average 208 tons; (3) Majestic, average 203 tons. The Terrible's record has, we believe, been beaten in some of the German coaling competitions; but the amounts handled are, of course, considerably less. The first few hours of coaling usually bring the coal in merrily; it is the "last few tons" that tend to lower the average.

ENGINES.

Turbine Engines for Passenger Ships—Notes on the King Edward.—Turbine engines for passenger ships cannot now be fairly classed among the novelties of engineering. In these days of keen competition, the development of novelties and the application of novel principles are rushed ahead at full pressure, and when measured by progress made it seems now a long time since the Turbinia, the first of the turbine steamers, startled the engineering world with a speed of 34½ knots per hour. That 34½-knot gait was raised in a subsequent vessel to 37, but still the bulk of engineers engaged in the production of ships designed for earning money took but an outside interest in the development. For warships of the destroyer class the absolute maximum of possible speed is the first thing to be desired, and the expenditure necessary to secure the extra space is a matter of comparatively small importance. In trading steamers, especially in those engaged in passenger traffic, speed is certainly desirable, but it is of importance that it should be accomplished with a due regard for economy. The desire of owners to possess fast boats is still held strictly subservient to the stronger desire that every ship in the fleet shall show a profit, and the turbine, in its early career, had the reputation of being a gluttonous devourer of coal.

So the experimenting was left to the inventor, the Hon. Charles A. Parsons, of Newcastle-on-Tyne, and the British Admiralty. A new era was, however, opened when the inventor declared his belief that the improved turbine was capable of entering into competition, on profit-earning ships, with engines of the reciprocating type. The assertion was received with some skepticism, for the turbine had still its old reputation for extravagance. To prove it the King Edward, a passenger steamer of a type in common use on the Clyde, was built early last year by Messrs. Denny & Company, of Dumbarton, Scotland. The builders, the Parsons Turbine Company, Ltd., and a captain of long experience in the Clyde passenger trade and the steamers by which it is carried, were all equally interested in the venture. The results of a long and hard season's work give valuable data for judging the accuracy of the claim put forward; but before proceeding to the consideration of these it may be desirable to present in detail the principal features of the ship, boilers and machinery.

To insure that accurate data on which the performance of the turbine might be obtained the King Edward was modeled as nearly as possible of the same size and same general design as the paddle steamer Duchess of Hamilton, one of the crack steamers running on the route for which the King Edward was designed. The latter is, however, of slightly greater draught and more displacement. She is also a little finer forward, and has a remarkably easy delivery. The weight of the motors, condensers, steam pipes, auxiliaries connected with the propelling machinery, shafting, propellers, etc., is 66 tons; which works out at about half the weight per indicated horsepower of the engines required for paddle steamers of the same type. Another advantage secured to the boat by the adoption of the turbine engines is that increased deck space is left available for passengers. This fact receives recognition in the Board of Trade certificate and is of assistance to the ship as a profit earner.

Steam is raised in a double-ended Scotch boiler of the ordinary type, 20 feet long by 16 feet 6 inches in diameter. There are four furnaces at each end, made to work under forced draught with closed stokehold. For purposes of comparison the capacity of the boiler under these conditions might be set down roughly at about 3000 indicated horsepower.

It is, however, in the steam turbine—the first engine to realize the dream of a perfect steam-driven rotary engine—that the chief interest in the craft is centered. The principle of the turbine is fortunately simple enough to make it easy of explanation. Inside the cylinder to which the steam from the boiler is led is a drum or hollow shaft studded with row upon row of blades or vanes, all set at an angle to the flow of the steam as the sails of a windmill are set to the breeze. It is apparent that the rush of steam, deflected from its course by the first row of blades, would not reach the next in such a direction as would allow it to do its work effectively. To meet this difficulty there are, between each row of the working blades, a row of guide-blades fixed to the inside of the cylinder casing and set at the reverse angle. These blades are stationary, and their sole purpose is to again alter the direction of the flow of steam and bring it back to the straight course from end to end of the cylinder before it meets the next succeeding row of working blades. The tops of the revolving blades reach nearly to the outer casing of the cylinder,

and the stationary blades project inward until they almost scrape the revolving shaft or drum. A series of turbine wheels on one shaft are thus constituted, each one complete in itself, like a parallel-flow water turbine; but, unlike a water turbine, the steam, after performing its work in each turbine, passes on to the next, preserving its longitudinal velocity without shock, gradually falling in pressure on passing through each row of blades, and gradually expanding. There is no rubbing friction and no wearing parts except the bearings on which the main shaft or drum revolves.

Early experiments proved that such an engine was only efficient when run at a very high rate of speed, and the first use to which it was put by the inventor was for the direct driving of high-speed dynamos. The first practical application of the new engine was made in 1884, when a compound steam turbine engine of 10 horsepower and a modified high-speed dynamo were designed and built for a working speed of 18,000 revolutions per minute. This machine proved successful, and after doing good work for some years is now preserved in the South Kensington Museum. Other developments on the same line followed, and then the experiments in marine work with turbine engines were started with the famous Turbinia. Many difficulties were met with, and when these had been overcome the next step was toward adapting the turbine marine engines to ordinary commercial uses. The fitting of the King Edward was the first application of the turbine to these uses, and the adaptations necessary are thus described by the inventor in a paper read to the Institution of Shipbuilders and Engineers in Scotland.

The machinery, he said, consists of three separate turbines driving three screw shafts. The high-pressure turbine is placed on the center shaft, and the two low-pressure turbines each drive one of the outer shafts. Inside the exhaust ends of each of the latter are placed the two astern turbines, which are in one with the low-pressure motors, and operate by reversing the direction of rotation of the low-pressure boilers and outside shafts.

In ordinary ahead going, the steam from the boilers is admitted to the high-pressure turbine, and after expanding about 5-fold it passes to the low-pressure turbines and is expanded in them to about another 25-fold, and then passes to the condensers, the total expansion ratio being about 125-fold as compared to 8 and 16-fold usual in triple-expansion reciprocating engines. At 20 knots the speed of revolution of the center shaft is 700 and of the two outer shafts 1000 per minute. When coming alongside a pier or jetty, or maneuvering in or out of harbor the outer shafts only are used, and the steam is admitted by suitable valves directly to the low-pressure motors, or into the reversing motors for going ahead or astern, on each side of the vessel. The high-pressure motor under these conditions revolves idly, its steam admission valve being closed, and its connection with the low-pressure turbines being also cut off by non-return valves. By this arrangement great maneuvering power is obtained.

The main air pumps are compound, and are worked by worm gearing from the main engines in the usual way. There are also small auxiliary air-pumps worked from the circulation engines for draining the condensers before starting. The other auxiliary machinery is as usual in vessels with reciprocating engines, and includes a feed-heater fed

from the exhaust steam of the auxiliaries, and also when necessary by steam drawn from an intermediate point in the expansion of the main turbines.

When this paper was read the all-important question as to how the engines would compare on coal consumption with those of the piston type was still a matter of conjecture, but in his summing up the inventor claimed for the turbine system of propulsion for fast pleasure steamers and passenger steamers of all classes as compared with vessels fitted with ordinary engines:

1. Increased speed for the same boiler power, due to considerably reduced weight of machinery, and increased economy in steam. (This advantage increasing with higher powers and speeds.)

1a. Same speed with reduced boiler power and reduced coal consumption for the same reason as paragraph 1.

2. Absence of vibration, giving greater comfort to passengers.

3. Increased cabin accommodation due to smaller machinery space.

4. Less upkeep in machinery and smaller engine-room staff.

From a money-earning point of view the claims made in paragraphs 1 and 1a are undoubtedly those of the first importance, and the tests to which they were submitted for proof or disproof were carried out with care and thoroughness. The results may be summarized in the following table:

	Duchess of Hamilton.	King Edward.
Coal	1,758 tons 13 cwt.	1,429 tons 16 cwt.
Mileage	15,604	12,116
Miles per ton	08.87	8.47
Number of days run	111	79
Daily average consumption	15 tons 17 cwt.	18 tons 2 cwt.
Average speed	16⅕ knots.	18⅕ knots.

In estimating the value of these figures it is important that the superior speed of the King Edward should be borne in mind. Every engineer knows that it is the knot or two extra that tells on the coal consumption; and to make 8.47 miles per ton of coal at a speed of 18½ knots is a much more handsome performance than to do 8.87 miles at a speed of 16½ knots. The test would have been more satisfactory had the length of the season on both steamers been more nearly alike, but the figures, even as they stand, give a distinct triumph for the turbine boat.

The other claims made on behalf of the turbine have been even more fully justified. The absence of vibration was remarked with pleasure by everyone who went aboard, for the engines ran so smoothly that it was only near the taffrail that the slightest shake could be felt. The small size of the propellers kept them immersed in practically all states of the sea, and even when contending against a heavy head swell, the absence of the usual jarring and concussion made the King Edward a remarkably comfortable boat to travel on.

As already pointed out, the increased cabin accommodation secured for her a certificate for a greater number of passengers than would have been granted had the usual amount of space been occupied by the machinery.

In the matter of care and maintenance of machinery she has proved one of the most economical boats ever turned from Denny's.—*Scientific American Supplement*, April 5, 1902.

THE NEW ERA FOR THE STEAM ENGINE.—Unquestionably, in the development of the steam engine, we are just now entering upon a new era, which, when steam has ceased to be used as a prime mover, and the history of the age of steam comes to be written, will be distinguished sharply from the first era, which is now apparently drawing to a close. To Watt, we take it, must always belong the credit of having opened, in a practical way, the era of the reciprocating steam engine, and to Parsons will belong the credit of being the first to demonstrate in a commercial sense that the term of usefulness of the reciprocating engine was, at least for the majority of uses to which it has been put, drawing to a close, and that the era of the simpler and more efficient turbine had arrived. In saying this we would be careful to emphasize the fact that as long as steam continues to be used, the reciprocating engine will, for some classes of work, continue to be the most serviceable motor. To particularize, we have only to refer to the steam locomotive, to convince everyone who is familiar with the demands and exigencies of locomotive service, that the turbine is never likely to displace the reciprocating engine in this class of work.

As an electrical drive, however, it is pre-eminently qualified, and since electrical power seems destined to indefinitely enlarge its field of application, the growth of the steam turbine in connection with the electrical industries is destined to be rapid and widespread. But although the turbine is not applicable directly to the locomotive and the street car, it is the ideal motor for the propulsion of steamships. This is said with a full appreciation of the fact that there are difficulties of reversing which limit the maneuvering power of a ship in entering or leaving a dock, or in making landings; for this objection has been largely overcome by the provision of separate reversing motors. In any case, the difficulty is so greatly outweighed by the economy of the turbine in weight and fuel, and by the advantages of a complete absence of vibration, that we look to see the steam turbine enjoy a monopoly, as a marine engine, second only to that which it will achieve in connection with electrical power on land. Indeed, the only classes of work to which the turbine may not prove to be immediately applicable are those which involve much starting and stopping, and considerable running at slow and intermediate speeds. In work of this kind the reciprocating steam engine will always find a limited sphere of usefulness, unless, indeed, even here it is driven out by the ubiquitous electric motor.

The advance of the steam turbine during the past few months, both in size and power, and in its application to large plants, has been quite remarkable. Two of the largest manufacturing concerns in this country have been for some years watching closely its development, and have themselves been conducting experimental work to determine its efficiency and to improve upon existing forms. Although the Parsons turbine is an English invention, and practically all the work with large units that has been accomplished has been done by these machines, it is a fact that the Westinghouse Company, which secured the rights for the Parsons turbine in this country, has already built, or is now building, eight turbines of from 750 to as high as 2500 horsepower. These Westinghouse-Parsons machines, as they are called in this country, have been giving most excellent results, and the 2500 horsepower turbine, which

has now been employed for about a year in an electric light and power plant at Hartford, Conn., is the largest turbine and probably the most economical steam engine in the world. In addition to these machines, we understand that the same company has received an order for a large turbine for South Africa, which is to be used in a big power-transmission scheme that is being worked out in the Rand gold fields. The General Electric Company have in operation at their works a 750 horsepower turbine of the bucket-and-nozzle type, the plans for which have been worked out by the company's engineers. This turbine has also shown excellent economy, and we understand that the company stands ready to manufacture it upon a commercial scale.

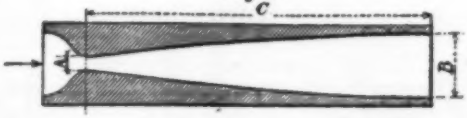
Most significant fact of all, pointing to the ultimate monopoly of the steam engineering field by the new type of engine, is the confidence with which the great railway and power companies are adopting the turbine in large units as a drive for electrical generators. We referred last week to the fact that the London underground railways were equipping a 100,000 horsepower plant with ten 10,000 horsepower turbines. We are now able to announce that it is only the conviction that nothing of an experimental nature must be allowed to enter into the equipment of the new Rapid Transit Subway's power plant that prevents its equipment with the steam turbine. As it is, only six engines of the reciprocating type have been ordered, and the balance of the order has been left open with the expectation of installing the turbine when there is a demand for the full power of the station. Reference was also recently made in these columns to the probability of the new 25-knot liners for the Cunard Company being driven by turbine engines, while a sister ship to the turbine passenger steamer King Edward, which did such good work on the Clyde last year, is under construction, and three large steam yachts have also been ordered in Great Britain which are to be equipped with the same motive power. Incidental evidence of the widespread appreciation of the fact that we are on the eve of revolutionary changes in motive power came to our notice the other day in the case of one of the largest steam yachts that has ever been planned in this country. At the eleventh hour the owner requested that the plans be held in abeyance for another season until the performance of the new British turbine-propelled yachts could be noted.—*Scientific American*, March 22, 1902.

Some Notes on Steam Turbines, by F. J. Warburton.—There are, I believe, some three ways of utilizing steam for the transformation of heat into useful work. In historical sequence, first, by directing a jet of steam on to movable objects, such as the blades of fans, or, in reaction wheels, by allowing the steam passage itself to revolve. Second, by condensing steam in a cylinder, and allowing the external atmospheric pressure to force a piston inward—Newcomen's engine. Third, by cutting off slices of high-pressure steam, and expanding in the cylinders of the modern reciprocating engine. The steam turbine designer, however, is merely concerned with the first and oldest method.

A perfect gas according to the kinetic theory enunciated by Bernouilli, Joule, Tyndall and others, consists of a number of molecules, equal in size and weight, moving in straight lines and bombarding the boundaries of the space they occupy. Dry hot steam is found to behave as a perfect

gas, and is considered as such in this paper. The simplest possible steam impulse turbine must consist essentially of a fixed nozzle guiding a jet of steam on to vanes arranged at the periphery of a rotating wheel in a very similar way to the buckets of the well-known Pelton water-wheel; but to turn this wheel efficiently it is necessary not only to make the nozzle of suitable dimensions and shape for the work to be done, but to form the vanes or buckets of the wheel so that they make the best possible use of the steam as delivered from the nozzle. The function of the nozzle is to convert the whole available energy of the steam into mass × velocity in the required direction. It should, therefore, be designed so as to expand the steam to the same pressure as that of the wheel chamber before the delivery on the vanes. If the nozzle is improperly formed, either the expansion will not be complete and the jet

Fig. 2.



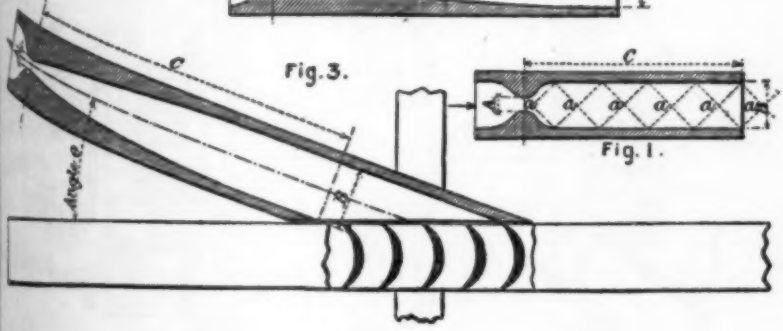


Fig. 3.

Fig. 1.

will burst into a cloud at the orifice, or eddy currents will be set up within the nozzle itself, and retardation of flow will be the result.

To arrive at the best shape of steam nozzle, the ratio of expansion required should be first decided, and the area of entrance—*A* in Fig. 2—should bear a relation to the orifice, *B*, in direct proportion to the increased volume of steam when expanded. The curve of nozzle walls is calculated to allow gradual expansion, until maximum velocity, due to initial pressure energy, is attained. Fig. 1 shows an example of what is found to take place in an incorrectly shaped nozzle. The steam particles rebound from the walls as shown by the dotted lines, and meeting at *a a a a a* form points of greatest pressure. Turning again to Fig. 2, if the length, *C*, is too great there will be retardation of flow due to the skin friction, and if *C* is too short the steam will not have time to expand completely. The area at *A*, then, depends on the quantity of steam to be passed; the area, *B*, on final pressure required, and the length, *C*, on the velocity of flow due to the difference between initial and final pressures. The best shape for wheel vane faces is undoubtedly as nearly a semicircle as is permitted by the angle Θ of the nozzle, Fig. 3. This angle is usually about 20 degrees, which is nearly the maximum possible.

While being of sufficient area to reverse the direction of current without shock or eddy, these vanes should be short, so as to minimize skin friction, and the edges should be sharp to avoid blanketing the nozzle. The most efficient mean speed of vanes is just under half the velocity of the steam current, thus leaving the exhausted molecules relatively motionless. For this reason single-disk turbines must revolve at enormous speed and be geared down for driving ordinary machinery. For example, a 10-inch De Laval turbine working at 70 pounds' pressure revolves 14,000 times per minute.

Geared motors are avoided like the plague by most engineers, and so the multiple step steam turbine was devised as a means for reducing the speed of rotation, and driving machinery direct. This idea was first

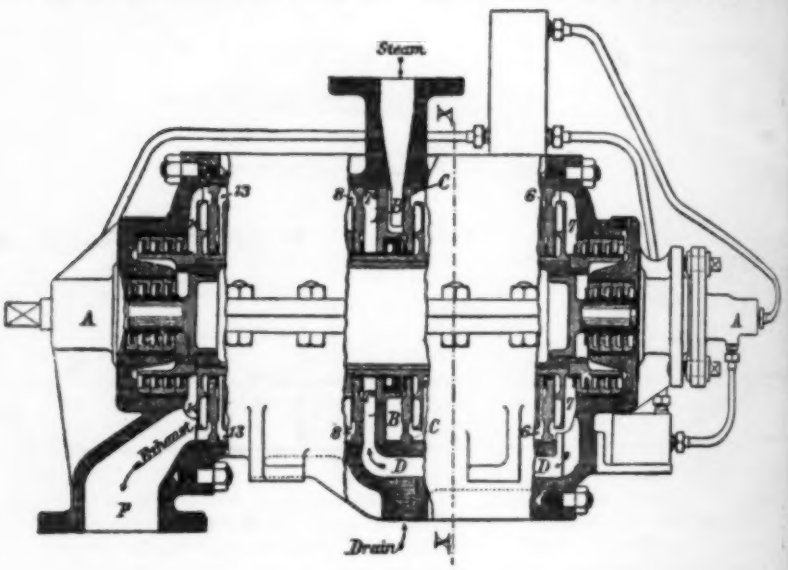
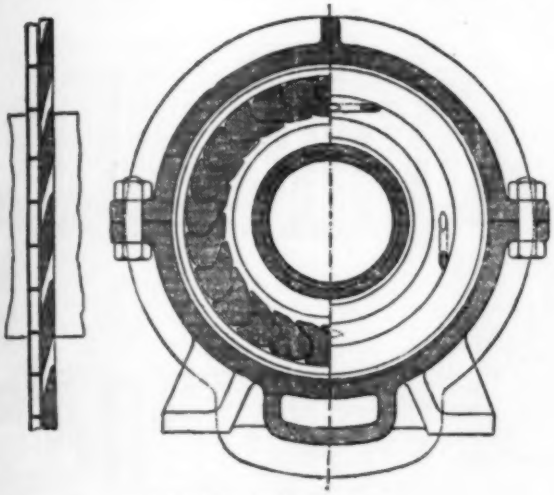


Fig. 4.

developed into a marketable commodity by Parsons during 1884-87. The earliest Parsons parallel flow turbine was a collection of zigzag nozzles whose walls were formed by projecting rings of blades intermeshing, and so arranged that the "zigs" were fixed to the inner circumference of a stationary hollow cylinder and the "zags" to the outer circumference of a rotatable cylinder. The modern Parsons turbines from which such notably economical steaming results have been obtained differ from the earliest—apart from improvements in mechanical and constructional detail—only in the alteration of the contour of the steam passages or nozzles from a zigzag to a sinuous shape. Instead of turning sharp corners the steam now traverses flowing curves, and the cross sectional area of steam channels increases in nearly exact proportion to the growing volume of steam as it expands to the exhaust pressure, the collective areas at each stage fulfilling more closely the conditions for a perfect

nozzle, as previously mentioned. But as expansion takes place both within fixed and moving blades, as the whole passage is one continuous nozzle, the clearances and workmanship must be of the finest to minimize leakage, which in the earlier machines was a serious trouble.

Prof. Curtis, of New York, has designed large steam turbines which follow Parsons' very closely in theory, but are differently worked out mechanically. Few revolving disks of comparatively large diameter are arranged, and the fixed steam nozzles only play upon part of their periphery, in some cases only two nozzles being employed on the first disk. Provision is made for altering the nozzle areas according to load by opening or closing their tapered walls, thus to a certain extent permitting correct maintenance of expansion ratios for varying steam pressures and loads. Prof. Curtis argues that his arrangement of few large



Section through XX.

Fig. 5.

nozzles and wheels in series lessens the percentage of waste through spilling of steam. In order to reduce the revolutions per minute as far as possible, Mr. Parsons appears to advocate a large number of turbines in series of small diameter, while Prof. Curtis believes in few wheels of large diameter. Apart from relative economy in steam consumption, the former appears to lend itself best to considerations of weight and space, and the latter to cheapness and simplicity of construction.

Prof. A. Rateau, in conjunction with Sautter, Harlé & Co., of Paris, has worked out a multiple step impulse steam turbine, consisting of a number of Pelton or Laval wheels arranged in series on a shaft, each wheel revolving in a separate chamber. Distributing nozzles convey the steam to the wheel vanes, and the whole of the expansion is accomplished within the fixed nozzles. The steam leaves the chambers at almost the same pressure at which it enters, the wheel vanes merely receiving the impulse due to the velocity of its particles; there is therefore

in this case no tendency to leakage and no necessity for fine fits or clearance. A machine of this type has been built of 1200 brake horsepower, and one is now in hand of 1800 brake horsepower, from which a steam consumption of 12½ pounds brake horsepower per hour is expected.

The multiple expansion steam turbine—shown in Fig. 4—was designed and made for experimental purposes some three years ago, and since that time has been carefully tested under various conditions, the object of the research being to collect a set of fundamental data for guidance in the design of large and efficient turbines, and also to investigate the best means of reversing in connection with marine requirements.

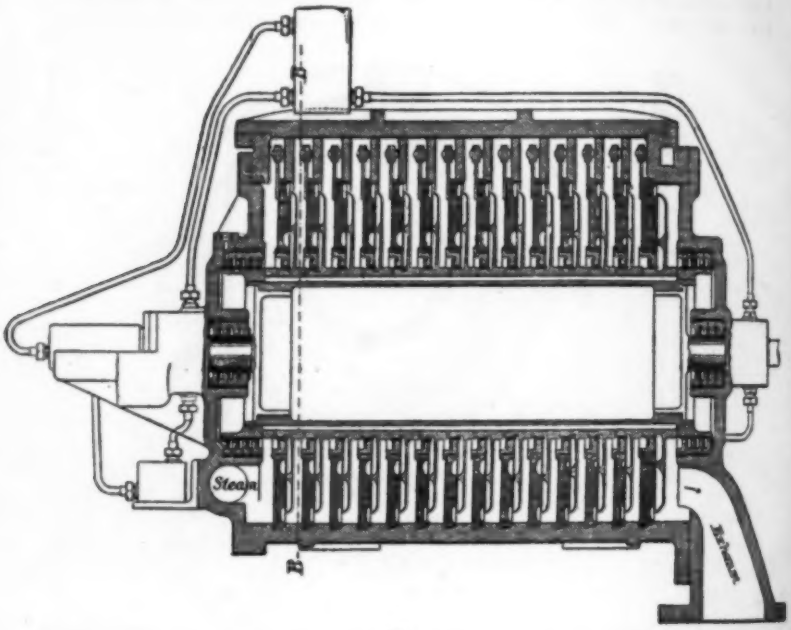
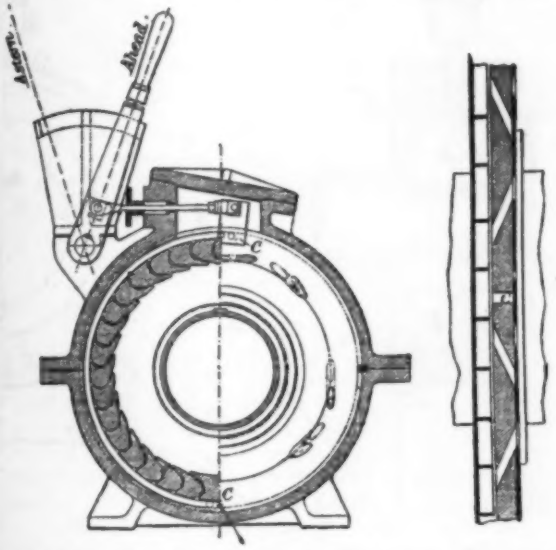


Fig. 6.

As the time is limited, I do not propose to consider the results obtained this evening, but hope to have the opportunity at some future date. A short description of two of the machines built may, however, be of interest. The first machine, Fig. 4, is a single direction motor. The longitudinal section shows fourteen wheels keyed onto a cylindrical shaft slung between resilient bearings, *A A*. Cells are cut into the inner faces of these wheels, and the walls of the cells form curved vanes. Each wheel revolves in a separate chamber. Steam at 75 pounds' pressure absolute is admitted to the center chamber, *B*—which contains no wheel—and is thence conducted to the vanes of the first wheel by four diagonal nozzles pierced through the partition, *C*. These nozzles are shown in the half cross-section through *X X*, Fig. 5, and also in the developed

section of nozzles and wheel. The curved vanes as nearly as possible reverse the direction of the jet, and the steam being passed over the outer periphery remains comparatively motionless in chamber 1. Similar but slightly larger nozzles guide the steam on to the wheel in chamber 2, and so on until No. 7 is reached, when a passage, *D*, of ample area conducts the flow to chamber No. 7 *A*, which, like chamber *B*, contains no wheel. It should here be noted that partition, *E*, is blank. From No. 7 *A* to No. 14 the steam expands by equal steps to the exhaust *F*, the collective nozzle areas being so arranged that each wheel does an equal share of work. Steam gauge connections to each chamber were provided and the pressure differences recorded. Each nozzle in each partition was tapered and formed to comply with the conditions just mentioned as far as possible. End packing and isolation of chambers was effected by means of floating packing rings of more or less L



⅛″ holes for drainage and equalization of pressure carried through all chambers but only open when lever is in central position.

Cross Section BB.

Developed Section.

Fig. 7.

section. These rings fitted well but freely on the shaft and were held against faces by the steam pressure. When running, it was found that they did not revolve with the shaft, but remained stationary, floating on an extremely thin layer of steam between ring and shaft. No internal lubrication was necessary—an important point for condensers and boilers—and no wear was apparent on rings or shaft. A wheel, ring, and partition plate which have been in use for some time are now on the table. This machine ran well at 5000 revolutions per minute, and was very fairly economical in steam consumption, especially with superheat.

The second machine, shown in Fig. 6, is a reversible motor. It reversed from 4000 revolutions per minute ahead to 4000 revolutions per minute astern in five seconds, giving 75 per cent power astern with the same steam pressure. In this case two oppositely inclined sets of nozzles are pierced in each chamber wall; the "go ahead" set playing on the most efficient side of the wheel vanes. If equal reversing power were desired the astern nozzles might have some 25 per cent more area. In front of each partition a very thin circular valve is arranged, containing ports corresponding to the nozzle entrances. These valves can be rotated through a small angle by means of a weigh shaft and lever. In the half cross-section, Fig. 7, the lever is shown with the valves in the

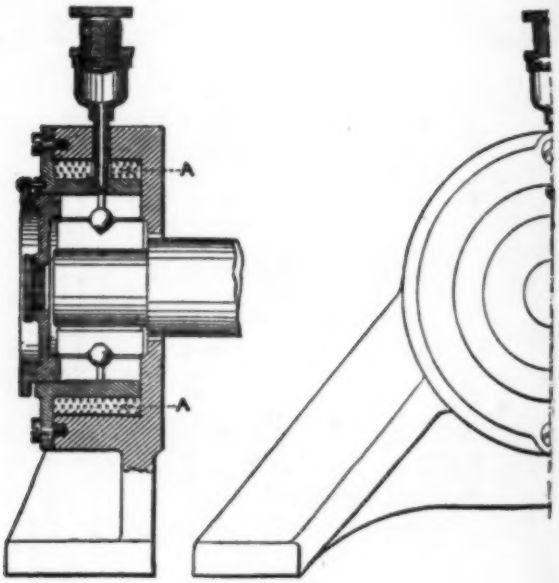


Fig. 8.

"go ahead" position, the "go astern" ports being closed. When the valves are in the central position, the small hole, *C*, is thrown open for draining and warming up purposes, also to prevent excessive accumulation of pressure in front of the first partition.

The last figure, Fig. 8, shows an arrangement of ball-bearing which was used successfully up to 7000 revolutions per minute. *A* is rubber, which absorbs the small vibration and allows the shaft to rotate in its true center of gyration, which hardly ever corresponds with its geometrical center on account of small inaccuracies of balance. I do not, however, particularly recommend these for general use, as it is so difficult to get really hard steel balls and races. The reversing valve mechanism described lends itself to modification. The same valve might be utilized for closing one or more nozzles in each partition plate at pleasure, thus altering the collective nozzle areas in use, and by maintaining correct

expansion ratios, permit the turbine to work at different speeds and pressures at its highest economy. This would be an important consideration for torpedo-boat destroyers, cruisers, and other vessels which make long runs at half or quarter power. Thus the engines of a ship which worked full power at 200 pounds' pressure per square inch might be "notched up" to work equally efficiently at 100 pounds' pressure, or cruising speed.—*Scientific American Supplement*, April 19, 1902.

GUNPOWDER AND EXPLOSIVES.

THE EVOLUTION OF SMOKELESS POWDER AND OTHER HIGH EXPLOSIVES.—Common black powder, which is a mixture of niter, sulphur, and charcoal, held its own against all other explosives as a propellant to be used in guns, and a bursting charge for shells, for several hundred years. It was simple, cheap, and easily made, and did not deteriorate with keeping, and it was quite strong enough for the guns which it was possible to make at that time. When black powder is ignited, the oxygen which forms a part of the niter becomes disassociated from the potash, and combines with both the sulphur and the charcoal. The sulphurous acid so formed in its turn combines with the potash which has been liberated, forming sulphate of potash, which appears in the air as a dense smoke.

When artillerists had arrived at the end of their tether, as far as black powder was concerned, they naturally sought something that would be stronger. Moreover, rapid-firing guns demanded that a powder should be found which was free from smoke. Guncotton in a compressed state, or in twisted cords, had been used to some extent, but had produced uneven results, and proved very unsatisfactory generally. However, a semi-smokeless powder was evolved which had guncotton for its basis, and which was extensively used in shot guns. This powder, however, was never very suitable for use in rifles.

When the Maxim gun first made its appearance, the amount of smoke which it evolved became very conspicuous. It was said at the time that one Maxim gun could pile up a cloud of smoke as big as St. Paul's in a few minutes. It therefore became obvious that if this gun were to go into use, it would be necessary to have something that would not produce this immense cloud of smoke, and very curiously the first smokeless powder suitable for use in rifles that seems to have been made was the result of experiments which were conducted for a totally different purpose.

In 1885 Mr. (now Sir) Hiram Maxim was called upon to design a large gun for throwing aerial torpedoes, 20 inches in diameter. Certain engineers and artillerists at the time were of the opinion that the Whitehead torpedo was nothing like so effective as had been supposed, and Sir Hiram was asked to design a gun that would throw a torpedo through the air instead of propelling it through the water. It was proposed to use compressed guncotton or some species of modified blasting gelatine for the purpose. A model gun was made, 4-inch bore, and experiments with high explosives were conducted in Scotland, under Sir Hiram Maxim's directions. Mr. MacRoberts, who then had charge of Nobel's Dynamite Works at Ardrossan, Scotland, became Sir Hiram's assistant and adviser. It was proposed to modify blasting gelatine by

adding a large percentage of cotton, at the same time depriving it of its air bubbles, and a machine was made for squirting the tough mixture, thus formed, through holes, and making it into cords in order to remove the air. Mr. MacRoberts claimed at that time that any degree of slow burning might be obtained by mixing a larger percentage of guncotton with the nitroglycerine. The apparatus employed was the subject of a patent (see Patent No. 2628, February 19, 1887).

Mr. MacRoberts made with this material cords of smokeless powder of the exact diameter and appearance of the cordite of the present day, and claimed that this was all that was required for a smokeless powder. However, there was a tremendous prejudice against nitroglycerine at the time, and Sir Hiram Maxim did not dare to present this material as a smokeless powder.

In 1888 Nobel took out his ballistite patent. This powder consisted of 60 per cent of soluble nitrocotton and 40 per cent of nitroglycerine. At the same time, and before Nobel's patents had been issued, Sir Hiram Maxim also commenced experiments with a view of making a powder which could not be objected to on account of its containing nitroglycerine, and we find that his first powder, made and patented in 1888, consisted of pure nitrocellulose modified in various ways. At that time Sir Hiram was informed that no powder would be looked at by the government that contained a trace of nitroglycerine. However, as his experiments went on, it appears that he practically returned to the old powder which had been made in Scotland in 1886 and 1887, for we find in his patents (No. 16,213, November 8, 1888, and No. 4477, March 4, 1889), mixtures of nitroglycerine and guncotton described. We further find that he used paraffin wax, and other hydrocarbons, as well as castor oil, in modifying his powders.

Fourteen days after Sir Hiram Maxim had filed his patent on a powder consisting of nitroglycerine, guncotton, and oil, Sir Frederick Abel and Professor Dewar filed a patent on substantially the same thing.

The next development in the powder question was when Nobel brought a suit against the government for infringement of his 1888 patent. Nobel claimed that notwithstanding that his specification called for a soluble nitrated cotton, there was in reality true guncotton in it, and consequently the government in making a compound of nitroglycerine and true guncotton had infringed his patent. But in the trial it was conclusively shown that in none of Nobel's patents—neither in the nitrogelatine patent of 1875 nor in the smokeless powder patent of 1888—had he used or described guncotton; but had always warned people off the use of this material, and therefore his patents were for the soluble kind of cotton, which was not guncotton at all. The true definition of guncotton, as distinct from collodion cotton, was never determined until this trial, consequently a good deal of the writing and correspondence that took place before this date proved rather confusing. The decision went against Nobel.

The next step was when Sir Hiram Maxim sued the government for infringement of his patent—the one in which true guncotton was called for. It was believed at the time that the government, in order to beat Nobel, had made an easy victory for Sir Hiram. Sir Hiram's patent called for about 15 per cent of nitroglycerine, although he had actually made powders containing all percentages from 60 per cent down to

only 1 per cent of nitroglycerine, and had sent a great number of samples containing 25 per cent of nitroglycerine all over the world. Sir Hiram's patent was for a powder consisting of nitroglycerine and guncotton modified with a suitable oil. The government admitted the validity of the patents, and Sir Richard Webster and His Lordship the Judge both explicitly stated that Sir Hiram Maxim was the first man in the world to make a gunpowder of nitroglycerine and guncotton. This was shown in the Nobel case as well as in the Maxim case, but they claimed that as the government powder had more than 50 per cent of nitroglycerine in it, it was essentially a nitroglycerine powder; while as Maxim's powder contained less than 50 per cent, it was essentially a guncotton powder. Moreover, the government claimed that they did not use an oil in their powder, but rather mineral jelly, which was in reality cylinder oil, but which was described by them as a hydrocarbon, and therefore the patent, although valid, had not been infringed by the government. This decision caused a great deal of adverse criticism at the time, and it was generally conceded that Sir Hiram Maxim was the original inventor of smokeless powder.

It is interesting to note that at this trial, although every patent ever granted to any one in the world relating in the least to the subject was thoroughly gone into, the name of no American, except that of Sir Hiram Maxim, was even mentioned as ever having contributed anything to the art of making smokeless powder.

The English government powder (cordite) is formed into threads for small arms, and into rods of considerable size for artillery, presenting an appearance identical with the original powder made by Sir Hiram Maxim and Mr. MacRoberts in Scotland in 1886-87.

In the action of Maxim against the government Sir Hiram Maxim was cross-examined, and in cross-examination stoutly maintained that he had kept down the quantity of nitroglycerine in his powder because he had found from actual experiment that the proportions in the British cordite were not safe. He said that it had too much nitroglycerine in it, that it would not keep, and, moreover, that it eroded the guns with very great rapidity.

The first French smokeless powder made its appearance about 1887, and is said to have been an imperfectly nitrated form of guncotton which would not keep. It is also said that the first lots of this powder made and delivered were destroyed on account of its instability, and that the next smokeless powder made by the French was highly nitrated guncotton—that is, tri-nitrocellulose—which was found to be sufficiently stable to be considered a reliable explosive to be used in small arms.

On the Continent of Europe "ballistite," as made by the Nobel Company, is still used by nearly all the important nations, with the exceptions of France and Germany, although the Germans have in the past used considerable quantities of ballistite. In Italy it is said that ballistite has done very well.

It is interesting to note that although ballistite only contains 40 per cent of nitroglycerine as against 58 per cent in the government cordite, the erosion is about the same in both kinds. This is brought about by the use of vaseline in cordite. Although the percentage (5 per cent) of vaseline is very small, nevertheless vaseline requires an immense amount of oxygen, and, consequently, when the powder explodes, this vaseline

converts a considerable quantity of the carbon dioxide into carbon monoxide, so that the products of combustion from the two kinds of powder are almost identical.

As far as erosion is concerned, it has been found that if the products of combustion are carbon dioxide, the erosion is much more violent and rapid than when the products of combustion are carbon monoxide. This is because carbon dioxide is much hotter than carbon monoxide; in fact, it may be said that a pound of carbon dioxide has to be heated twice as hot as a pound of carbon monoxide in order to occupy the same space and to produce the same pressure.

Although Professor Boys had experimented and had testified in the Maxim cordite case that the erosion was almost exactly in proportion to the amount of nitroglycerine employed, the government still adhered to their large percentage, and it was only after a large number of guns had been injured and some destroyed that they finally made up their minds to drop the percentage of nitroglycerine to 30 per cent, so that the government cordite explosive from this time is to contain only 30 per cent of nitroglycerine, which is well within the limits of a guncotton powder.

Smokeless powder was first made into cords in the winter of 1886-87 by Sir Hiram Maxim. Pure nitrocellulose was first made into small cubes by the French about the same date, and into cords and cubes by the British government in 1889-90.

About two years later the Russians employed artillery powder in long ribbons.

Shape of Powder.—Experimenters soon ascertained that the shape of the powder was an important factor in the results obtained. It appears that Sir William Anderson was one of the first to take out a patent on making smokeless powder into tubes, but it does not appear that he made any. However, in 1890 and 1891, Sir Hiram Maxim made various kinds of smokeless powder tubular in shape, and a quantity of this was taken to France and used in a 37-millimeter (pom-pom) gun, where it did considerably better than the French powder.

When smokeless powder is employed in the form of a sphere or a cube, the cube burns smaller in all directions; consequently the surface on which the flame is operating is rapidly diminished in all directions. If, however, the powder is formed in long strips, the amount burning from the ends is immaterial; consequently the reduction only takes place in one direction—that is, in the diameter of the cord, and therefore the reduction of the burning surface is only half as rapid as it would be in cubes or spheres. When this same powder is spun into tubes or flat sheets, the burning surface practically remains constant from the first to last. In the case of a tube, if we do not take into account the length, which is immaterial, we shall find that the powder is burning smaller from the outside and larger from the inside; consequently the approximate area on which the flame works is constant.

Sir Hiram Maxim patented powders of various forms, some of them having a considerable number of fine perforations running through the entire length of the sticks, but in order to allow the flame to enter it was necessary to cut these sticks so that they appeared in blocks only about 4 or 5 calibers in length. In this form of powder the actual burning surface could be increased instead of diminished. It was early

ascertained that a wave action was set up in the chamber of the gun when smokeless powder was used in large charges, and in order to prevent this, Sir Hiram Maxim patented powder having perforations running through the entire length, but cut open at the sides so that the flame could enter from the side, and the sticks, being the whole length of the charge, prevented the wave action to a considerable extent. This patent appears to have been the first ever granted to any one on multiple perforations, although multiple perforations had been used in black powder many years before.

Any one would naturally suppose that as the actual burning surface is increased instead of diminished, the multiple perforated variety of powder would be very effective, much more so than others, because it would maintain the pressure for a longer time; and it was found by actual experiment that when multiple perforated powder was employed in old-fashioned guns, where the pressure was low and the projectile short, it produced results much better than any other form of smokeless powder. However, when this powder was employed in new guns, where the pressure was very high and the projectiles from 3½ to 4 calibers long, it was found to be very erratic indeed.

The first experiments in England demonstrated that when multiple perforated powder was employed in about three-quarter charges, it did considerably better than three-quarter charges of powder in sticks; but when any charge greater than a three-quarter charge was attempted, great unevenness and erratic action took place, the pressures and velocities becoming very irregular; and when very nearly a full charge was employed, the pressures suddenly mounted to about 25 tons per square inch, which was considered a very dangerous pressure.

Powders are not always used at the same temperature. It very often occurs that the powder itself is at 100 degrees before it is loaded into the gun at all, and then if the gun has been out in the sun at all, and has also been fired a few times, the chamber may be considerably above 100 degrees; consequently it is always necessary to give powders what is called a "heat test," and here again the multiple-perforated variety behaves very badly indeed.

The Americans, who do not seem to be so critical as the English, were the first to experiment on a large scale with a multiple-perforated variety of powder. It did very well in guns of low power, and also in a 10-inch gun with a three-quarter charge; but when a full charge was employed, the charge went off with the violence of dynamite, blew the gun into fragments, and, notwithstanding that the detachment were in a bomb-proof, the bomb-proof was destroyed, and the detachment killed or wounded. At that time it was believed that the compound, which was nitroglycerine, guncotton, and soluble cotton, was to blame, and various articles were written to point out what the trouble was, and why it was that this powder behaved in such a peculiar manner. A quantity of the same kind of powder was sent to England, and tested by one of our leading artillerists. It produced very good results, until a three-quarter charge was employed. When, however, fired in full charges, the action became very erratic and the pressure high and dangerous. In lecturing upon the powder, the "Artillerist" said: "This is a very interesting powder, but it is apt to produce extraordinarily high pressures."

Although the Americans have ceased to use their nitroglycerine com-

pound, and are now using pure nitrocellulose, still we learn that recently one of their 5-inch guns has been destroyed, and it is interesting to note that it was in a hot climate at the time of the accident, which would seem to point to the fact that the temperature of the gun had something to do with the bursting. Moreover, a considerable number of accidents have occurred with American artillery on board ship. In some cases 13-inch guns have had their rifling completely torn out, which is probably due in some measure to extremely high and violent pressures being unexpectedly set up in the chamber of the gun, which are so sudden and intense as to ignite the bursting charge of the shell by the shock.

We propose now to show why it is that multiple-perforated powder is dangerous in use. When a charge of smokeless powder in the open is ignited, it burns slowly away. However, if several tons of it are piled up together, the rate of burning will constantly increase, and by the time half the pile has been consumed the rapidity will have increased up to the detonating point, when the remainder will go off with as much violence as dynamite. This was shown by what is known as the Plumstead Marshes experiment, where a large quantity of cordite was piled up and ignited in the open, the last half of it detonating, making a pit in the ground 15 feet deep and 24 feet in diameter, and causing a great amount of damage in the immediate vicinity.

If a charge of smokeless powder were placed in the chamber of a large gun, and the projectile secured in position so that it could not move, the charge would commence by burning slowly; but as the pressure increased, the rapidity of the burning would be increased, which would react upon the pressure, increasing the rate of burning still further. Thus one would react upon the other, and by the time that one-half of the charge had been consumed by this accelerated combustion, the remaining half would go off with all the violence of dynamite.

Let us see now what it is that prevents this from happening every time a charge of smokeless powder is ignited in a large gun. When the charge is ignited, the pressure causes the projectile to move forward in the bore of the gun. This not only gives more room in the chamber, but at the same time a certain percentage of the heat is converted into dynamic energy. We also find that if the powder is in sticks or blocks, the burning surface is being constantly diminished. We therefore have two agencies—the heat operating upon the pressure, and the pressure upon the heat—which tend to accelerate the burning of the powder; and two agencies—the increase in the volume of the chamber and the reduction in the burning area—which tend to diminish the rate of burning; and when powder is employed in blocks or solid sticks, the two agencies which operate to reduce the rate of burning are always sufficient to prevent the pressure from mounting to a dangerous point. When, however, powder is employed in multiple-perforated blocks, the burning surface increases, and we therefore have three agencies which tend to increase the rate of burning and the pressure, and only one which serves to reduce it. Is it any wonder, therefore, that the powder produces extraordinarily high pressures? A curious thing about it is that often hundreds of rounds may be fired without any manifestation of high pressure, when suddenly, without any rhyme or reason, a charge will go off like so much dynamite, and destroy the gun. Experiments with

powders with only a single perforation, on the Continent, occasionally show the same phenomenon, but in less degree. Moreover, it has been found that the density of loading with multiple-perforated powder cannot be anything like so great as the density with solid sticks. As a whole, therefore, artillerists are of the opinion at the present moment that powder in solid sticks is the safest and best, everything considered.

Recent developments in England have shown that very good results can be obtained with a powder which is all guncotton, and contains no nitroglycerine at all, and which seems to work equally well whether it is in the form of solid sticks or in tubes.

Bursting Charges.—Many years ago it was discovered that indigo could be nitrated, and that the product, instead of being blue, like indigo, was a very brilliant yellow. This new chemical was called picric acid, and was employed in the arts as a dyeing material for many years before it was known to be a high explosive. However, some twenty years ago a fire broke out in Manchester, at a place where a quantity of the material was stored in close proximity to some high explosives. The high explosives went off, and the picric acid seems to have followed suit. At any rate, the result was an explosion, the violence of which was perfectly astounding. No one at that time could account for the remarkable results, and it was assumed that the picric acid must have been set off by the explosion of the adjacent high explosives. Investigation by the Home Office demonstrated that picric acid was one of the most violent explosives known. The French were the first to take advantage of this new discovery, and Eugene Turpin, a French chemist, commenced a series of experiments. He found that although picric acid was a very insensitive compound, and that it might be burnt in large quantities without any danger of exploding, yet if it was properly confined and set off with a strong detonator, it produced disruptive effects superior to dynamite—in fact, astonishing results. His next attempt was to employ this material as a bursting charge in projectiles; but he found that the shock due to striking an armor-plate was sufficient to detonate the charge, so that picric acid went off before it passed through the plate. He continued his experiments, however, and found that by mixing a small percentage of thick petroleum oil with this material, its sensitiveness could be sufficiently reduced to enable it to be shot through armor-plates without exploding. He also found that it could not be exploded by placing it on an anvil and striking it with a sledge-hammer; and the picric acid thus modified was ultimately taken up by the French government, the material forming the basis of the melinite of to-day.

When this remarkable explosive was first employed by the French, the French officers were never tired of boasting of its efficiency and its safety, and it was their boasting, together with the purchase of a very large amount of carbolic acid in England, that led the British authorities to suspect that the new explosive, for which so much was claimed, must have picric acid as its basis. Picric acid, it should be understood, is not made from indigo at the present time, but, like a great many other high explosives, is made from nitrated coal-tar products. Chemically, it is known as "tri-nitrophenol." The extraordinary results obtained in France led our own Experimental Committee of 1888-89-90 to take up the subject. They found that pure picric acid would stand all

the tests which the French had boasted about, except one. When placed on an anvil and struck with a sledge-hammer, it went off. They found that if picric acid were placed in a receptacle and slowly heated, it would evaporate and pass off into the air without taking fire. However, if cold picric acid was dropped into the same receptacle at the same temperature, the sudden heating that it received caused it to go off every time. The discovery of this curious property led to very important results, for it showed that when picric acid was loaded into a projectile and shot against an armor-plate, the sudden compression of the air, etc., in the forward end of the shell was sufficient to raise the temperature to a point at which the picric acid would be ignited and set off.

The next step was to reduce its melting point, which was successfully accomplished by the addition of a small percentage of dinitrol-benzol, a substance which is very similar to picric acid, but which melts much more easily. With this addition it was found quite impossible to heat the mixture up to the boiling point so quickly as to set it off. It would always melt before it exploded. This was a most important discovery. Our Explosives Committee not only experimented with dinitro-benzol, but with a great number of other nitrated bodies, such as trinitro-toluene, trinitro-cresol, trinitro-manite, nitro-benzoline, naphthalene, dinitro-naphthalene, and also with nitrated cotton, and nitroglycerine, as well as with various kinds of oils and hydrocarbons. It was found, however, that dinitro-benzol, everything considered, was the best, and that the sensitiveness could be modified still further—in fact, to any desired extent—by the admixture of a very small quantity of vaseline.*

When pure picric acid is loaded into an armor-piercing projectile, it will generally detonate by the time that the point of the projectile has entered the plate 3 inches, although there have been cases where 6-inch projectiles, charged with pure picric acid, have been fired through 5 inches of armor-plate. A good deal depends upon how the charge is loaded into the projectile, and also upon the presence of air-bubbles, which are dangerous to the pure acid. If we mix only 1 per cent of pure vaseline with picric acid, we shall find that its insensitiveness has been greatly increased, while the mixture of about 3 per cent makes it almost impossible to detonate it by shock or blow. For armor-piercing projectiles a mixture of

87 per cent picric acid,
10 per cent dinitro-benzol,
3 per cent vaseline,

is sufficiently insensitive to pass through almost anything without any danger of going off by shock. Of course the amount of these deterrents can be modified according to the velocity and length of the projectile. In small projectiles very little modification is necessary; but in large projectiles, where the velocity is not only very high, but the length of the charge very great, the charge has to be very insensitive, otherwise it will go off.

The fuse to be used with picric acid is an extremely important question. No matter how insensitive the charge may be made, there cer-

* The materials used for modifying picric acid in lyddite have been kept a profound secret until quite recently.

tainly must be something about the fuse which will go off by shock; and if the fuse goes off by shock when it strikes the plate, it will certainly set off the charge before the projectile has had time to penetrate the plate. A delayed action of about one-thousandth part of a second is therefore necessary, and it cannot be produced in any ordinary way. It is quite out of the question to obtain any chemical compound that will give the necessary delayed action. Moreover, a highly sensitive compound, like fulminate of mercury, cannot be employed safely. A premature explosion with black powder simply means a slight damage to the rifling of the arm; but a premature explosion with picric acid means not only the destruction of the gun, but also of the lives of the detachment. It is therefore very obvious that it will not do to employ any fuse which, in case it should go off prematurely, will ignite the main bursting charge in the arm. The question of a safe delayed-action fuse was attacked as long ago as 1885 (Patent No. 6591, May 30, 1885, and No. 17,252, December 15, 1887) by Sir Hiram Maxim, who got round the trouble in the following manner:

He used a very strong fulminating charge placed at a considerable distance to the rearward of the projectile, and inclosed in a strong tube forming part of the projectile. This charge was so far removed from the main bursting charge that a premature discharge ruptured the tube and went off harmlessly inside the gun chamber. However, when the projectile struck the target and was retarded, the detonating charge moved forward as relates to the projectile, not only giving perfect safety, but at the same time the necessary delayed action, which would admit of the projectile passing through the plate. It will be understood that when the projectile struck the target, the fulminating charge entered the base of the projectile, and was sufficiently strong to open a communication from the inner tube to the bursting charge, thus igniting the main charge. This arrangement seems to be the only one with which any degree of safety has ever been obtained.

There has been a great deal in the newspapers during the last year regarding experiments in the United States of America with picric-acid compounds. It was first said that the compound employed was a secret. However, the material has been analyzed, and has been found to be a mixture of picric acid, dinitro-benzol, and vaseline, and in this respect is identical with the original picric-acid compound—lyddite—made by our own Explosives Committee as long ago as 1889.

Various experimenters in the States seem to have submitted specimens of explosives, but the picric-acid compound made by a Captain Dunn, of the United States Army, proved to be the best, everything considered. It is alleged that the results which have been obtained in the States are superior to anything that has been obtained in England; for whereas in England the picric acid is said to explode on the surface, in the States Captain Dunn's compound has successfully passed through a 12-inch plate, and exploded after having passed through. This is not due to anything new in the explosive, but altogether to the peculiar form of delayed-action fuse carried out on the original plan laid down by Sir Hiram Maxim in his patent, which plan has been worked out in the United States by Captain Dunn. The detonating charge is placed in such a position that it does not receive a shock at the instant that the projectile has been sufficiently slowed up to allow the fuse to overtake

the projectile, and to come in contact with a point of resistance, or a detonating point, which in its turn bursts the tube and ignites the main charge.

The success of the experiments in the States is due therefore to the delayed-action fuse made on a principle which has been well known in England for many years.

The original English lyddite, which was modified with both dinitrobenzol and vaseline, is a very remarkable explosive, and to the lay mind it appears to be nothing less than marvellous. It may be safely stirred up with a white-hot iron. If placed on an anvil and struck with a sledge-hammer, it refuses to go off. It may be driven into a piece of tool steel without exploding. It may be thrown into a white-hot furnace without exploding. It may be boiled away in a sauce-pan and dissipated into the air without even taking fire. It may be melted in hot water and then cast into shells with the greatest ease, where it solidifies, forming a dense and compact mass. It may be mixed with black powder, and the black powder exploded, without even igniting the lyddite. If placed on a cold piece of iron, it may be set on fire with a white-hot iron, and will yet continue to burn so long as it is in contact with the hot iron, though so soon as the hot iron is removed, the flame will go out of itself. If loaded into a projectile, it may be shot through an armor-plate without exploding. But that it produces remarkable effects when it does explode is witnessed by the experiments of Sir Andrew Nobel, who showed that a cast-iron projectile had been reduced by its action to an impalpable powder having the appearance of lamp-black.

Picric acid forms the basis of a great many "ites," no less than thirty being shown in the English "Dictionary of Explosives," and on account of its peculiar qualities it has shown itself to be a very potent instrument in the hands of charlatans for deceiving the uninitiated. It appears no less than marvellous that a high explosive can be manipulated with white-hot irons without exploding.—*Engineering*, May 2, 1902.

WET GUNCOTTON AS THE BURSTING CHARGE FOR SHELL.—Naval and military authorities have for years past been, and are still, seriously occupied with the question of high explosives as the bursting charge for shell. Wet guncotton is known to be, in its wet state, a perfectly safe, uninflammable, and inert explosive in the absence of a detonating force. It may consequently be stored aboard ship, or conveyed and used with land forces, without any special precautions, and without the slightest risk from any cause whatsoever. It is absolutely under control. It will keep in any climate unimpaired for an indefinite period. Wet guncotton is not so locally violent as "lyddite," its disruptive effect and ensuing damage is therefore much greater. "Lyddite," too, is not employed in shell of a smaller caliber than the 4.7-inch gun, owing to the uncertainty of its detonation in smaller bodies. Wet guncotton, on the other hand, may be detonated in small as well as large quantities with perfect certainty. The only obstacle to its general use for shell purposes hitherto has been the circumstance that to ensure complete detonation a primer of dry guncotton and a fulminate of mercury detonator have been required, and both of these agents are too sensitive to premature ignition by friction heat or concussion to permit their employment under the conditions of shell-firing at the present day, owing to the high

pressures and great velocities attained with modern artillery. The combination, however, is still the most useful and successful form for torpedo work, and constitutes the latest practice method of charging and exploding these submarine "shells" by all navies.

The means therefore of adapting the wet guncotton successfully for general shell work has long been sought, and after many years of experiment and research, The New Explosives Co., Ltd., of London and Stowmarket, have at last been able to place before the War Office a new safety exploder, the composition of which contains neither dry guncotton nor fulminate of mercury, but which will detonate wet guncotton with certainty under the safest conditions. The composition itself will not detonate under a temperature of 360 degrees C., and cannot be ignited by friction or shock, but at the same time is brought instantaneously into action with an ordinary detonating pellet such as is commonly employed in all percussion or time fuses of general service to-day. The force then exerted will detonate in its turn any charge of wet guncotton, without leaving any traces of unburnt explosive or residue. The composition is very stable and stands an excellent heat test, and it is not affected by any climatic changes, and in cost of manufacture it is less than guncotton.

Recently some extensive official trials were carried out by The New Explosives Co., Ltd., at the Ridsdale Range.

The main bursting charges were made by the Company's new method of forming and compressing wet guncotton, whereby it is now possible to produce charges of compressed gunpowder in one whole solid block of any dimensions, mechanically true, and of theoretical and uniform density throughout.

With the old method of work certain practical difficulties have prevented the direct formation of "shaped" blocks such as are required to form the bursting charges for shell and for torpedoes, and it has hitherto been the practice to build up such a charge from a number of discs, and to reduce them to the required shape and size in the lathe. By the new process such charges can be formed in a single block without any subsequent turning or other shaping being necessary.

There is no space wasted as is the case with built-up charges through slightly imperfect contact between the individual blocks, and thus, either a heavier charge (i. e., about 15 per cent more guncotton) can be got into the same space, or less space will be occupied by a charge of given weight.

The first experiment consisted of firing ten rounds from a 6-pounder quick-firing gun. The total weight of each shell as fired was 5 lbs. 10½ ozs., the weight of the wet guncotton bursting charge being 100 grams and that of the explosive in the safety exploder nine grams.

The shell was fitted with the ordinary Hotchkiss fuse, Mark IV. The target was a ¾-inch steel plate at a range of about 150 feet. In the rear of this were two heavy steel coils, forming a cell seven feet long, backed by a 12-inch plate, to confine the fragments, which were afterwards collected, counted and weighed. The propellant employed was ordinary government cordite, service charge, 7¾ ozs. The table on next page describes the fragmentation of the shell, and the chamber pressures and muzzle velocities for each round.

Rounds.	Chamber Pressure.	Muzzle Velocity. f. s.	Recovered of Shell.			Recovered of Brass.			Recovered of Gas-Check.			Largest Piece Recov'd.		Total Weight of Shell Recov'd.	
	Tons.		Pieces.	lb.	oz.	Pieces.	lb.	oz.	Pieces.	lb.	oz.	lb.	oz.	lb.	oz.
1st ..	not taken.	not taken.	102	4	4	7	—	1⅜	3	—	⅛	—	4	4	5¼
2nd ..	"	"	143	3	15	14	—	⅝	9	—	¼	—	8¼	3	15¾
3rd ..	11.28	1,800	67	3	9	14	—	¾		none.		—	3½	3	9¾
4th ..	12.26	1,827	104	4	4½	6	—	¾		none.		—	6⅝	4	5¼
5th ..	12.39	1,838	154	4	2	10	—	1⅜	6	—	¼	—	6⅛	4	4½
6th ..	not taken.	not taken.	135	3	14½	8	—	1		none.		—	6½	3	15¾
7th ..	"	"	84	4	3	10	—	¾		"		—	7¼	4	3¾
8th ..	"	"	222	4	3¾	9	—	⅝		"		—	7¾	4	4½
9th } 10th }	"	"	306	8	6	31	—	2½		"		—	6	8	8½

The second experiment was the bursting of a 6-inch shell at rest. This was done in a closed cell of wrought iron 7½ in. thick by 3 ft. 6 in. in diameter by 5 ft. deep, weighing 6½ tons, from which none of the fragments could escape, the main object in this instance being to demonstrate that the wet guncotton charge and safety exploder would act equally satisfactorily without the assistance of the shock of impact at a short range, and detonate as instantaneously and energetically (1) as if fired from a gun, and (2) in large as well as in small quantities. The results here obtained were also very much appreciated by all present. The force of the explosion burst the coil open. There were no traces of unconsumed explosive; the fragments recovered numbered 2122 pieces, the largest weighing 10⅛ ozs. and the total 65¼ lbs.

The shell was an ordinary cast steel one, weighing, fully loaded, as fired, 119½ lbs.

The wet guncotton charge weighed 6 lbs. 9 ozs., and the explosive composition in the safety exploder 300 grams. The fuse employed was of the ordinary service direct-acting pattern, and was fired electrically.

Before the trials commenced it was convincingly proved that the guncotton charges contained the usual amount of moisture, viz., about 18 per cent of water, and that there was no dry guncotton or fulminate of mercury employed in the composition of the safety exploder, and in view of the very excellent results obtained it seems highly probable that guncotton shell charges will become more generally employed, especially in armor and deck-piercing projectiles, for which purposes it appears to possess advantages which cannot be claimed for any other high explosives. With a delay action fuse wet guncotton with this new safety exploder can be fired through the thickest armor plate that the shell itself will penetrate without exploding until if has passed through; this cannot be accomplished with "lyddite" or any other known high explosive.—*United Service Gazette.*

GUNS.

Considerable progress has lately been made by the Navy Department in the direction of introducing guns of larger caliber and higher muzzle

velocity. The advance applies to ordnance of all calibers, and an increase of weight results from the adoption by both the Army and Navy departments of nitrocellulose powder, from which all nitroglycerine is excluded. In a gun of 50 calibers the use of the new explosive causes the charge to approximate in weight to half that of the projectile. The initial velocity is much increased, and with the 5-in. 50-caliber gun a rate of 3380 foot-seconds has been recorded, with a pressure of 16.43 tons. The service velocity of this particular gun is 2900 ft. An interesting development is the use of 7-in. hard-faced armor plates, instead of 6-in. plates for the casemates of battleships, which has led to the introduction of a 7-in. gun. This latter gun, of 45 calibers, has a projectile of 165 lb. weight and a muzzle velocity of 2900 ft. It was not adopted until after much discussion, for many officers favored an 8-in. gun as the next superior to the 6-in. gun. The latter has a projectile of 250 lb., with a velocity of 2800 foot-seconds, but it was rejected owing to the difficulty of mounting it on a ship's broadside, owing to the limited space between decks.

The latest 6-in. 50-caliber gun used in the Japanese navy is wire-wound for about half its length, and is from 5 to 10 calibers longer than those now in service. The total length is 309.73 in.; length of bore, 30 in.; weight of projectile, 100 lbs.; weight of cordite charge, 29 lbs.; weight of nitrocellulose charge, 47 lbs.; corresponding velocities for both powders, 3000 foot-seconds; corresponding energy, 6240 tons; maximum pressure in gun, 15.5 tons; total weight of gun, 7.98 tons.

The United States Bureau of Naval Ordnance have finally adopted the Welin plug on all 5-in., 6-in., 8-in., and 12-in. guns, of which a large number are in process of manufacture. The United States Government in 1898 adopted this plug, together with the Vickers 6-in. breech mechanism for their 6-in. guns, and the success of this mechanism has led to the introduction of the screw for the remaining calibers of their naval artillery. The same breech-screw is now being utilized in all the new artillery employed by the British Government for land and sea service.

The Chief of Ordnance of the Navy has received a report from the North Atlantic Squadron on the recent target practice held in the waters of the West Indies. The report is especially interesting in view of the explosion of the 5-inch gun on the battleship Kearsarge which, according to report, burst five feet from the muzzle without any apparent cause. It is probably due to a defect in the gun itself. The Ordnance Bureau is experimenting with shells fitted with gas checks to prevent premature explosions, as in the case of guns on the Alabama and Kearsarge. The report states that during the target practices thirty cells fitted with these gas checks were fired from the battery of the Kearsarge without a single accident and that every evidence goes to show that the new gas check has solved the problem of preventing the premature explosion of shells.

Vickers Guns for Spain.—An important trial of a 14-centimetre quick-firing gun, designed and constructed at Sheffield by Vickers, Sons, and Maxim, Limited, was carried out at Cadiz from the Official Spanish Government's Polygon at Torregorda. The trials occupied three days,

during which various series of rounds were conducted with projectiles of 79 lb. and 88 lb. weight, the velocities being 2737 ft. and 2632 ft. per second with the respective shot. The rapidity series resulted in a rate of fire of six aimed rounds per minute, each round striking a target 2 meters square at 1000 meters range. The breech mechanism of the gun was of the latest Vickers construction, employing the "De Bange" system of obturation, which does not entail the use of the metallic cartridge case, and thereby saves the necessity for carrying much weight on board ship. The general arrangement of the mechanism was generally similar to that employed by the British government, with an additional firing mechanism for enabling a high rate of fire to be obtained with a percussion firing arrangement. The powder charges were of pure nitrocellulose manufactured at the powder mills of Santa Barbara, where an extensive plant exists for the supply of nitrocellulose powder for the Spanish marine. The mounting for the gun was of the casemate type, and admitted of a high rate of aimed fire. The whole of the material worked throughout the experiments without a hitch.—*Engineering*, April 4, 1902.

In a rapidity test of a five-inch rapid-fire gun on balanced pillar mount at Sandy Hook proving ground, five rounds were fired in one minute and one second—separate loading. A test of a five-inch field howitzer carriage gun having recoil on carriage and a spade provided with hydraulic spring cylinder is in progress. The first ten-inch disappearing carriage, L. F., Model 1896, built under contract by the Midvale Steel Company, has been undergoing test. It could be trained 360 degrees in one minute and fifty-five seconds; gun elevated in twenty-two seconds; depressed in one minute and forty-five seconds, and the gun lowered by the retraction mechanism in three minutes and three seconds. Range sights for fifteen-pounder Driggs-Seabury gun have been graduated up to 7000 yards by range firing.—*Army and Navy Journal*, April 5, 1902.

One of the fastest pieces of gun repairing work of which the Navy Department has been aware has been reported to Rear Admiral O'Neil, chief of the bureau of ordnance. Some time ago the lining of one of the 5-inch guns on the Kearsage was injured by the premature explosion of the shell. An entirely new lining was put in the gun, which had been expanded to the necessary degree, and the whole operation occupied just one minute and forty seconds.—*Army and Navy Journal*, March 8, 1902.

THE EXPLOSION ON H. M. S. MARS.—Until an inquiry has been held, and a report published, it is impossible to state with certainty the cause of the explosion on H. M. S. Mars, by which 12 men and officers were killed, and several others wounded. The facts that have been published are that firing trials were being made with one of the forward 12-inch guns; that there was a misfire; that after an interval the breech was unlocked, and immediately was blown open, the charge of the gun pouring out flames rearwards, filling the barbette, and killing the majority of its occupants instantaneously. If these facts are correct—and there is no reason to doubt them—it is easy for any one with a knowledge of cordite and other smokeless powders to supply a complete explanation of the event. The rapidity of burning of an explosive, particularly of

the modern type, depends on the pressure under which it is burnt. This statement sounds somewhat cryptic, but its meaning may be made clear by an illustration. If fulminate of mercury—one of our most dangerous and unstable explosives—be ignited in vacuum, it will merely burn with a flame like that of alcohol; there will be no explosion whatever. It is not the absence of oxygen that makes the difference, but the want of pressure. As the vacuum is reduced, the combustion grows gradually more intense, until eventually it becomes instantaneous—that is, the substance detonates. It is impossible to create an explosion in a vacuum with any known agent. We may, however, go further and add that many substances will not explode unless all artificial pressure be first imposed upon them. Picric acid is an example of a substance which needs intense pressure. If lighted in the open, it burns slowly, like pitch, giving off dense black smoke. It is only when under an exceedingly high pressure—something like 20 tons on the square inch—that its full force is exhibited.

It only needs a superficial appreciation of these facts to make it clear that the subject of providing ammunition for guns is a very difficult one. When the charge is inflamed, the combustion is very moderate. But as it takes place in a confined space, and as there is an evolution of heat and gas, the pressure rapidly rises. This increase of pressure augments the rate of burning, and that again adds to the pressure, which in its turn quickens the combustion, and so on, the two acting and reacting on one another, until the full pressure is developed and the projectile is delivered at the desired velocity. Evidently it is a very delicate matter to so proportion the amount of the charge, the size of the chamber, and the inertia of the shot, that just the right pressure shall be attained, and no more. For instance, if cordite be cut into fragments and loaded into a shot-gun with a couple of wads over it, it will ignite sufficiently to blow out the wads and itself also. But if the charge be caught, it will be found that the combustion became extinguished before 10 per cent of the charge was burned. There was not pressure enough, after the wads moved, to keep the charge alight. But if an ounce of shot had been rammed in after the wads, quite a different state of affairs would have been created. The inertia of the shot would have prevented it being blown out of the barrel before sufficient gas had been generated to cause a high pressure, and the result would be a violent explosion, not without danger to the experimenter.

In large guns similar phenomena may be observed. It is not to be assumed that if a quarter charge will give a certain pressure, a half charge will give twice that pressure, and a full charge four times. The increase is vastly greater than the arithmetical ratio, and it is only by careful experiment that it can be prevented from becoming excessive and uncontrollable. With very small charges, which do not nearly fill the gun chamber, it is difficult to ignite the cordite at all. To do so it is necessary to create a pressure in the chamber by a secondary charge of some kind, generally of black powder. The igniter is then a small gun in itself, which projects a mass of flame into the chamber, inflaming the cartridge all over its base, and filling the vacant space with hot gases under pressure. It is only under these conditions that cordite can be expected to explode.

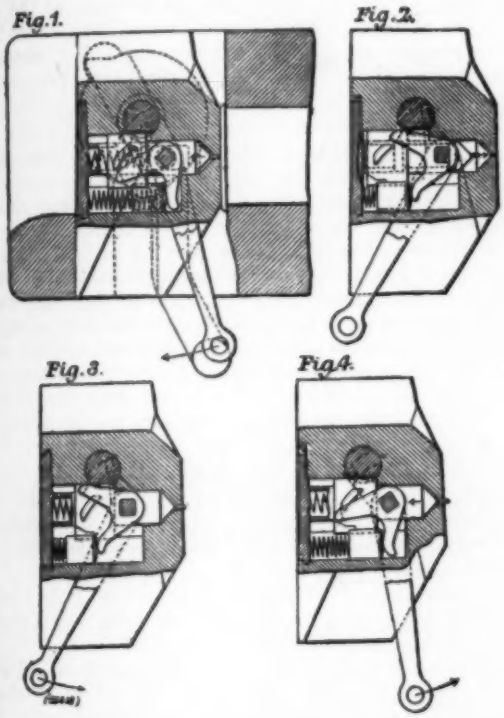
We are accustomed to speak of explosion as instantaneous, but in reality there are greater differences in the rates of explosions than between the speeds of a child's go-cart and a locomotive. The time taken for black powder to burn is almost an eternity as compared with the detonation of nitroglycerine. Cordite is relatively slow-burning, and it is quite possible for the artificially-created pressure in the gun-chamber to be lost before the combustion of the charge is really active. The effect of the cold walls is to create an immediate contraction of the gases; but this, of course, is foreseen and allowed for in the original charge. If, in addition, the gun has been so badly eroded by previous firing that there is a wide clearance all round the gas-check on the base of the shot, then the pressure can escape almost as fast as it is generated, or, at any rate, before the cordite is well alight. As is well known, the worst effects of erosion are felt just where the base of the projectile stands in the bore.

From a review of the above considerations it is easy to construct an hypothesis as to the cause of the disaster on the Mars. The igniter was fired and no effect was seen; then, after an interval, it was assumed that the charge had not caught fire, and the breech was unlocked. But evidently the charge had become lighted, for the first act of unlocking the breech broke the electric circuit, and no further action of the fuse was possible. What occurred was probably this: The igniter set fire to the cordite, but the pressure leaked away so rapidly that only slow combustion resulted. The charge smouldered away during the several minutes that the gun's crew waited, and in doing so it liberated a considerable amount of heat and gases. It gradually became hotter, and the rate of combustion increased, and at last became sufficiently rapid to create the pressure needed for explosion. At that fatal moment the breech was unlocked, and was immediately blown back, leaving a clear way for a torrent of flame to fill the barbette.

How are such accidents to be avoided in future? The first remedy is to have an explosive which does not erode our guns so badly as cordite. With well-fitting projectiles the pressure cannot escape so rapidly. The second is to provide a secondary charge which will burn more quickly than black powder, and therefore will not be affected by leakage. Some years ago Sir Hiram Maxim was consulted by the French government, who were in a difficulty from the misfires of automatic machine guns, such as pom poms. He provided a complete remedy by adding to the primers of the cartridges discs of highly nitrated canvas, which produce so much heat and pressure as to insure the certain explosion of the smokeless powder. He found that the amount of nitrated cotton necessary to effect his purpose was only one-tenth of that required to effect a measurable increase of pressure in the chamber of the gun when fired. Thus, although he obtained a powerful and reliable igniter, he did so without introducing any new conditions into his ballistics. Evidently the prevention of such lamentable accidents in large guns must be sought on similar lines. Means must be found for creating a sudden and regulated pressure which will insure the ignition of the main charge.—*Engineering*, April 25, 1902.

FIRING MECHANISM.—This invention relates to those means for firing guns in which, on pulling the trigger, the striker spring is first compressed and then released for the purpose of shooting forward the striker,

and is automatically returned to its initial position after the trigger has been pulled, whether the charge has been fired or not, in order that the firing gear may, if desired, be again operated without its being necessary to manipulate the breech-block. In firing gear according to this invention a cocking lever adapted to be operated by the trigger acts upon the striker spring and upon the striker, whose movement in the breech-block is guided. The cocking lever is influenced by a spring that bears against the back cover of the firing gear, and is adapted to maintain it in position

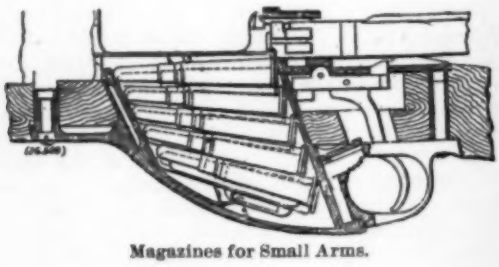


in the breech-block, and also to hold the striker ready for firing. When the trigger is pulled, the cocking lever first withdraws the striker and compresses the two springs; whereupon the striker is released, and is caused by means of its spring to move forwards. The second spring comes simultaneously into action and returns the released trigger to its initial position, whereby the cocking lever and the striker are also returned to their original positions, so that the firing gear is again brought into position for use. To obviate risk of firing the gun when the breech-block is not completely closed, the trigger is provided with a projection that can enter into a groove formed in a bolt that is adapted to be rotated by a cam lever only when the breech-block is completely closed and the cam lever in position corresponding thereto.—*Engineering.*

At the proving ground near Scheveningen, Holland, field guns recoiling on their carriages from the works of Schneider & Co., at the Creuzot, France; of Ehrhardt, at Dusseldorf, and Krupp, at Essen, Germany, underwent comparative trials. A series of twenty rounds were fired in 160 seconds by the Schneider gun, in 60 seconds by the Ehrhardt gun, and in 49 seconds by the Krupp gun. Besides this supremacy in the speed of firing the Krupp also showed superior accuracy. There is an even more important point in which the Krupp gun surpasses its rivals and which ought to be carefully considered in comparative trials, namely, the time required for the delivery of the first round after the gun is in position. This will, all other things equal, be of the most serious consequences in real warfare. In other words, the gun that opens fire first will be victorious; it may even prevent the other gun from firing at all.

A trial of a 14-cm. quick-firing gun, constructed by Vickers, Sons and Maxim, Limited, was carried out recently at Cadiz. Series of rounds were conducted with projectiles of 79 pounds and 88 pounds weight, the velocities being 2737 feet and 2632 feet per second with the respective shot. The rapidity series resulted in a rate of fire of six aimed shots per minute, each round striking a target two meters square at 1000 meters range. The breech mechanism of the gun was of the "De Bange" system of obturation, which does not entail the use of the metallic cartridge case. The general arrangement of mechanism was similar to that employed by the British government, with an additional firing mechanism for enabling a high rate of fire to be obtained with a percussion firing arrangement. The powder charges were of pure nitrocellulose.

A new gun put into some of the Spanish warships is 21 inches 46 feet long; length of bore, 248 inches; weight of projectile, 88 pounds; weight of cordite charge, 20 pounds; weight of nitrocellulose charge, 31.5 pounds; corresponding velocities, 2614 foot-seconds and 2880 foot-seconds; corresponding energies, 4169 foot-tons and 4991 foot-tons: maximum pressure in gun, 17 tons; total weight of gun, 5.925 tons. It is not wire-wound, and has an inner and outer tube extending the full length, and a very long jacket. Both jacket and outer tube are put on from the muzzle with a taper of 1 in 500 with the usual shrinkage; and the breech-plug is housed in a ring screwed into the outer tube from the rear. The breech is further reinforced by an external hoop.



Magazines for Small Arms.

MAGAZINES FOR SMALL ARMS.—P. Mauser, Oberndorf, Germany. Rifle Magazines. This invention relates to rifle magazine base-closing and spring feed devices, and is adaptable to the Mauser rifle having a magazine containing ten cartridges. In one arrangement the bottom shutter of the magazine has one end of the feeding spring attached, the other end of the spring slidably engaging within a slot in the feeding plate. The fixed end of the feeding spring may be attached to the upper part of the base shutter.—*Engineering.*

LIQUID FUEL.

LIQUID FUEL FOR STEAMSHIPS.—But a few years ago a serious discussion of the possibility of the general substitution of liquid fuel for coal on steamships and locomotives was out of the question, for the reason that the output of oil was inadequate to the supply of more than a very small percentage of the world's steam tonnage. In proof of this it is interesting to refer to the experience of the Pennsylvania Railroad, when the rapid development of the Pennsylvania and Ohio oil fields led to an investigation of the possibilities of oil as a locomotive fuel. While the engineers of this company were engaged in designing the best form of firebox and apparatus for burning oil it occurred to someone to make an estimate of the total amount of oil which would be necessary to run all the locomotives on that great system. The result showed that they would consume more oil than the total output of the United States oil fields of that date.

Although there have been extensive discoveries of oil in various parts of the world, and a great development of special fields such as that at Baku, Russia, the question of the widespread use of fuel oil for locomotives and steamships was governed, up to three or four years ago, by the very limited supply. The government report on the subject for 1901 gives the total output of petroleum for the whole world in 1900 as 135,000,000 barrels. The production in the United States for the same year was 63,000,000 barrels; but in 1901, as the result of discovery and exploitation of the Texas oil fields, the output went up 1200 per cent to 720,000,000 barrels. There has been an enormous increase also in the world's production, due to the remarkable oil fields in Borneo and Burma. It is impossible to estimate with any accuracy the present world's output, but that it is sufficient to make the supply of oil comparable with that of coal is seen when we bear in mind that to-day there are at least 250 wells in the Texas oil fields alone, which up to last week have shown a flowing capacity of from 50,000 to 160,000 barrels per day. From this we see that during the "gushing" period the rate of output, assuming an average yield of say 25,000 barrels per well, would be equal to a yield of something like two billion gallons per year from the Texas oil fields alone. The gushers, however, are subsiding, and the oil will ultimately have to be drawn out by pumping; but, even allowing for this, it is evident that the oil wells of Texas, California, Borneo and Burma, the four new fields, will yield enough oil to render the general use of liquid fuel in the steamships of the world quite a possibility.

Having eliminated then the question of the scarcity of fuel, it can be said that, looking at every other possible condition of cost, bulk, fuel

value, ease of storage, economy of space and wonderful convenience of manipulation in firing, there is everything to be said in favor of liquid fuel at sea. The experience already had with crude oil proves that there is as much fuel value in two tons of oil as in three tons of our coal at $3.50 a ton, and it is found that oil takes not much more than half as much space, weight for weight, as coal, 40 cubic feet of oil being equivalent to 70 cubic feet of coal. As regards the relative cost of the fuels, taking $3.50 as the average price per ton of steam coal as delivered in the bunkers in New York, we find that Texas oil, to compete with this coal, must be delivered on board at about 75 cents per barrel.

There are strong indications that before long fuel oil will be available for steamships in New York at this price and possibly for something less. The question that is confronting the owners of the Texas oil wells is not how much oil is available, but how to get the oil out fast enough to supply the demand. In spite of all the efforts that have been made, the consumption for the past few months has only been a fractional part of the capacity of the wells, a large number of which have been capped and are only awaiting increased transportation facilities by rail and sea before they are opened either to flow by natural pressure or be drawn upon by pumping. The railroads are making heroic efforts to transport the oil, and there are now several large tank steamers under construction at the various Atlantic shipyards. A number of pipe lines have been built from the wells to Port Arthur at the mouth of the Sabine Pass, and it is probable that within another twelve months the shipments from Beaumont will have increased enormously. As to the price at which the oil will be delivered in New York, it is difficult to predict with any certainty. There is a charge of ten cents per barrel for carrying oil through the pipe lines to Port Arthur. At the wells oil is selling as low as six to eight cents a barrel, and there is a rate of forty-five cents per barrel from Port Arthur to New York city for tank steamers. At that rate the actual cost at present of the oil delivered in this city would appear to be something over sixty cents a barrel.

It would seem, therefore, that fuel oil to-day could be sold at a profit and yet compete in price with steamer coal, the two fuels standing in this respect upon an equal footing. The enormous advantages of fuel oil, however, become manifest at once when we consider the question of storage in the ships and use in the furnaces. Thus, taking such a vessel as the Kronprinz Wilhelm, which carries about 4500 tons of coal in her bunkers, we find that instead of 4500 tons of coal she would require on the basis of two to three only 3000 tons of oil, a clear saving of 1500 tons of dead weight. On the basis of bunker space allotted, there would be a saving of about 90 per cent, and this in a high-speed express steamer like the Kronprinz Wilhelm, which can carry at the best probably not more than 500 or 600 tons of freight, when running with coal, would be of enormous value; for the fuel oil has this great advantage that it can be stored in the cellular double bottom of the ship, leaving the entire bunker space for increased stores and cargo. Furthermore, the use of oil would cause an immediate and very great reduction in the boiler-room staff. There would be no need of an army of coal passers and firemen; for the oil burners, when once started, require nothing more than the intelligent oversight of a few first-class firemen whose duties would be rather those that fell to an engineer of the lower grade.

It is estimated by Mr. Clement A. Griscom, of the American Line, that by the use of fuel oil on their ships the boiler-room staff could be reduced 80 per cent. There are, moreover, other subordinate but very important advantages arising from the use of fuel oil, such, for instance, as the great ease and cleanliness of taking the fuel on board, for it would flow into the double bottom through pipes by gravity, and there would be none of the objectionable dust and dirt which is inseparable from coaling a vessel. As to its convenience for a ship on an extended journey, there are at present over thirty localities throughout the world where the fuel is stored and may be secured, and the number of storage stations will multiply rapidly as the fuel comes into more general use.—*Scientific American*, May 24, 1902.

Oil Fuel.—We have frequently heard of late years the cry of warning because of the rapid consumption of available coal. Whereas the eventual destruction of the coal fields is a remote possibility, yet at present we now have opened up to us, through the discovery of the oil fields of Borneo and Texas, a supply of cheap liquid fuel that seems almost inexhaustible. For many years the great fields of the Alleghanies and Russia have supplied the world's demands for mineral oil for lubricating and illuminating purposes and for the various arts, but the supply has not been large enough to warrant oil being used generally as a fuel. In these two great fields of Borneo and Texas, located almost diametrically opposite on the earth's surface, with the auxiliary fields of Pennsylvania, California and Europe, we find sources of supply well located for the general distribution of oil. At present fleets of steamers are engaged in transporting the oil to the cities of the world, and the shipyards in this country are being filled up with orders for oil barges and steamers to further augment this fleet.

Oil is an ideal fuel for use on board ship, and the many experiments which are being carried on at present assure us that the difficulties of burning oil under a marine boiler will soon disappear. These experiments are being conducted by several companies independently of each other, and the reports received at present indicate that the success attained is so great that the companies are to equip more steamers with oil burners. It is stated that not less than fifty steamships have been fitted out with oil burners by a single English company. Two of the transatlantic lines, and many others traversing the Atlantic and Pacific, are also equipping their ships for this fuel.

The prejudices against oil as a fuel are thus disappearing in view of its many advantages. The relative heating value of oil and coal are about as 1.7 to 1 per unit of weight, and the space required for stowing a ton of oil is about 35 cubic feet in comparison to about 45 cubic feet for coal. The oil can be stored in the water bottom or ballast tanks of ships, thus occupying unavailable space, and throwing open for cargo space formerly occupied by the coal bunkers. The question of securing complete combustion has already been solved, so that no smoke nor soot are formed. On account of the lighter weight of oil per unit of heat the carrying capacity of a ship is also increased. The largest economy is found in the saving of labor, for with oil, not only are there no ashes to remove, but one competent fireman can perform the work of four or five men when coal is burned. In loading the oil, much less

time is required than in loading coal, for the liquid can be taken on board in port through a hose from tank barges at the wharf, similarly to receiving fresh water supply.

It is difficult to compare the cost of the two kinds of fuel, owing to the several elements of labor in the stoke-hold and in loading, space saved, which would otherwise be devoted to cargo space, and first cost of the material. As to the latter item, with coal containing about 14,000 B. T. U., at $4 a ton, the cost of oil for the same amount of heat raising power would be about 90 cents per barrel of 42 gallons.

It is generally conceded that it is necessary to heat the oil before piping it to the burners. In former installations these heating coils were placed in the uptake, where they were subjected to a high temperature as a result of which carbon was deposited on the inside of the coil, and, in one or two instances, the coil eventually burned out and the oil flowed down into the boiler causing disastrous fires. Now, a temperature of 140 to 180 degrees for the oil seems to give the best results, and this heating is secured by coils placed in settling tanks through which exhaust steam is passed. To remove the water from the oil, two settling tanks are provided. The size of these tanks depends on the amount of water found in the oil; the percentage of water in Texas oil is very small and the tanks are therefore of a size sufficient to contain but three or four hours' supply. If the water is not removed and enters the burner it puts the flame out, and, when the oil enters again, it runs into the furnaces unconsumed and is liable to cause severe explosion.

Most of the appliances heretofore used have been adapted to the present type of Scotch boiler, and some of the burners have been so arranged that the furnace can be used for burning coal also. This does not appear to be good engineering, and we may look forward to the day when a new boiler will be brought out to meet the special requirements of oil fuel.

It appears to be the general belief that a large combustion space must be provided and that the gases should have direct contact with the plates of the boiler rather than having a brick lining intervene. There are many patented burners on the market, all with good points about them, but the greatest success seems to be found with the burners which use oil, and air or steam at a low pressure. The function of the burner is simply to divide the oil into a fine spray and mix it with the proper quantity of air for complete combustion. Satisfactory results have been obtained with oil under about 20 pounds' pressure and the air under 8 to 16 ounces' pressure. The disadvantage of using steam for spraying the oil on board ship lies in the fact that larger evaporators must be supplied to make up the quantity of water used for the purpose of spraying, which varies from 2 to 10 per cent of the total evaporation. The total power required for the air and steam blast will be found from about 5 to 15 per cent of the power developed. The most successful experiments appear to have been made with hot air forced or induced-draft systems, such as the Howden, and Ellis and Eaves, where the entering air is first heated by the escaping gases.

Certain it seems that, with the large supplies of fuel oil and the many advantages of this kind of fuel, we shall soon find many of our steamers burning oil under the boilers.—*Marine Engineering*, May, 1902.

LIQUID FUEL FOR SHIPS.—*Comparative Advantages and Disadvantages for War Vessels.*—The problem that confronts every designer of a warship is the combination of the greatest speed, armament and ammunition supply, protection, and range of action, in the smallest and least expensive hull, and any reduction of weight and stowage room of any of the necessary elements of any of these qualities is a saving which acts and reacts favorably upon the problem in a manner familiar to us all. The practical figures of comparison between coal and oil fuel realized in recent practice are that two tons weight of oil are equivalent to three tons weight of coal, and 36 cubic feet of oil are equivalent to 67 cubic feet of coal as usually stored in a ship's bunkers; that is to say, if the change of fuel be effected in an existing war vessel, or applied to any design without changing any other of the data than those affecting the range of action, the range of action is increased by 50 per cent upon the bunker weight allotted, and nearly 90 per cent upon the bunker space allotted.

The coal protection for cruisers, whatever its real advantages—a matter upon which different opinions exist—would disappear with the use of liquid fuel, because it would be for the most part stowed below the water-line, if not wholly in the double bottom. The double bottom and other spaces, quite useless except for water stowage, would be capable of storing liquid fuel, and the space now occupied by coal bunkers would be available for other uses. The ship's complement would be reduced by the almost complete abolition of the stoker element and the substitution of a limited number of men of the leading stoker class to attend to the fuel burners under the direction of the engineers, and the space of stokers' accommodation, the weight of their stores, together with the expense of their maintenance, would be saved. The number of lives at risk, and of men to be recruited and trained over a long series of years would be reduced, without reducing the maneuvering or offensive or defensive power of vessels of any class in the fleet.

Rebunkering at sea—so anxious a problem with coal—would be made easy, there being no difficulty in pumping from a store-ship to a warship in mid-ocean in ordinary weather; 300 tons an hour is quite a common rate of delivery in the discharge of a tank steamer's cargo under ordinary conditions of pumping. The many parts of the boiler fronts and stokehold plates, now so quickly corroded by the process of damping ashes before getting them overboard, would be preserved by the action of the oil fuel, and the same remark applies to the bunker plating, which now so quickly perishes by corrosion in way of the coal storage.

Liquid fuel, if burned in suitable furnaces with reasonable skill and experience on the part of the men in charge, is smokeless. It is easy to produce smoke with it, but this is evidence of its being forced in combustion, or of the detailed arrangements of the furnace being out of proper proportion to each other. In regard to smokelessness, it is, when used under conditions customary in the merchant service, not inferior to Welsh coal, and superior to any other coal ordinarily in use. The cost of fuel in the East is less than that of Welsh coal when the cost of transport and Suez Canal dues are added to the original price of the coal as delivered in a Welsh port.

The evaporative duty required from the boilers of destroyers is greater than that required for boilers of any other type, and, whilst it is possible

to burn enough liquid fuel to produce the required duty in boilers hitherto using coal at natural draught, or even coal at moderate forced draught, difficulty has been found in burning enough oil fuel in boilers of the destroyer type to produce the same duty as that realized under coal at great air-pressure. The question of economy of fuel in destroyers when at full power is of comparatively little importance, but the production of the maximum power is essential; and further experiments now in process will probably solve the difficulty as it has been solved in locomotive practice on the Great Eastern Railway by the skill and enterprise of Mr. Holden.

Messrs. Yarrow have obtained some highly encouraging results in two torpedo boats built by them for the Dutch government. Their process is to obtain the maximum speed with coal under all usual conditions of forced draught, and then to inject liquid fuel into the furnace above the coal, thus securing additional boiler duty, while leaving the whole of the grate surface available for coal combustion. The result was to increase the maximum speed of the vessel by over one knot per hour. Messrs. Thornycroft have recently made experiments, and have obtained the high evaporative duty of 18.95 pounds of water per pound of oil fuel. The extra rapidity of raising steam with liquid fuel is undoubted, and this is a feature upon which much stress has been laid in recent naval debates. So far as experience has shown there is no deterioration of liquid fuel, however long it is stored before use.

Comparative Advantages and Disadvantages for Mercantile Ships.—The conditions which fuel must fulfil in the case of a mercantile vessel differ only in some respects from the conditions applying to a war vessel, the chief difference being that of cost. The question of direct cost is of little importance in a war vessel, provided the advantages above-named are really secured in practice, but in a commercial vessel the direct cost of fuel, although here also necessarily merged in other questions, is of the first importance. The saving of stokers is considerable, although the complement should not be reduced below that necessary to assist the ship's engineers in overhauling, or in case of emergency. In some instances a stoker's and trimmer's crew of thirty-two is now represented by a fireman's crew of eight hands, whose duty, however, is mainly cleaning and helping the engineers with their greasing.

In the case of medium-sized vessels working with natural draught, the advantages of uniform steaming, irrespective of wind and ventilation, and of large reserve of steaming power, are the same for liquid fuel as for every other system of forced draught. The greatest commercial gain, however, is the increase of weight and space available for freight. Adopting the proportion of 3 tons coal as equal to 2 tons oil fuel we find a gain in weight of, say 1000 tons in the freight of a first-class Atlantic steamer, and a gain of nearly the whole of the bunker space, which, subject to drawbacks of non-stowage in the hot parts of the bunker space, would be available for measurement freight. Allowing for these, and assuming the storage of the whole of the fuel in the double bottom and peaks, there would be a gain approaching 100,000 cubic feet of measurement made available for freight in such a vessel. The gain from substituting the new fuel in vessels of less steam-power proportionate to the size would be correspondingly reduced, but it may be fairly esti-

mated for most ships that 25 per cent of the space now occupied by coal bunker storage could be utilized for cargo by the transfer of the fuel in a liquid form to the double bottom and other parts not now of any direct use.

The cleanliness of oiling instead of coaling passenger ships, and the saving of detention at ports of call, are obvious. The provision of storage and pumping and ventilation arrangements and of the furnace gear are a disadvantage both as regards cost and weight, and in some ships trouble and expense has arisen from boiler leakage consequent upon the presence of water in the oil, and the lack of experience of the engineers, but these difficulties are now disappearing, and latest developments are in the direction of simplicity and less first cost. Oil fires do not require cleaning, thus avoiding a prolific source of lost speed in ordinary voyage routine.

From an address delivered by Sir F. Flannery at The Institution of Naval Architects.—The Engineer, March 21, 1902.

TORPEDOES.

There was recently carried out on the firing-ground at Marma a series of trials of the so-called "air torpedoes," which have been invented by Major Unge of the Swedish army. The torpedoes were charged with explosives, which in some cases consisted of dynamite, with a view to ascertaining the rotation of the torpedoes. The torpedoes are propelled by centrifugal force, and they explode on hitting their mark after having travelled in a definite and uniform course. The charges of dynamite proved to be quite free from danger. The exact results of the trials have been kept secret, but it appeared that with the low elevation of 15 degrees the torpedoes travelled more than 1333 yards.

Two new gyroscopic steering gears for use in torpedoes have been tested in the United States. One has given good results. A feature of this new device is that it can be so adjusted that after the torpedo has been launched the torpedo will turn in the water through a predetermined horizontal angle, and then take up a straight course. Further experiments are in progress.

WIRELESS TELEGRAPHY.

Its Past and Present Status and its Prospects.—Long before the dawn of the Christian era wireless methods of communicating intelligence to a distance were employed—not electric telegraphs as the term is generally understood, it is true, but wireless they certainly were, and perhaps as this article proceeds it will not be difficult to perceive a close relationship, as regards the nature of the communicating medium employed, between some of the wireless telegraph systems in vogue thousands of years ago, especially those that employed the luminiferous ether as the communicating medium, and the wireless telegraph systems of

to-day, in which case it would simply be another verification of the old proverb, "There is nothing new under the sun."

Polybius, the Greek historian, describes a telegraph system employed for military purposes, 300 B. C., in which torches were placed on high walls in prearranged positions to correspond to letters of the Greek alphabet, and by a suitable manipulation of the torches messages were thus transmitted to a distance. The Gauls, too, were wont to transmit important intelligence to a distance by a cruder but simpler method. A messenger was sent to the top of a hill where he shouted his message, apparently to the winds. Soon from afar a remote voice answered him, and this voice repeated the message to another listener further on, and thus, from one to another, the message sped, and it is recorded that in three days a message calling all the tribes of the Gauls to arms travelled in this way from Auvergne to the forests of Amorica in one direction and to the banks of the Rhine in another.

Later on came another wireless telegraph system—the semaphore telegraph—and this was in operation all over Europe prior to, and for some time after, the introduction of the electric telegraph. This semaphore telegraph employed arms on posts akin to those seen to-day along every railway in the world, and a certain position of the arms, like the torches in the Polybius system, corresponded to certain letters of the alphabet, and by varying the position of the arms as required, experts were able to transmit messages from one station to the other at the rate of two or three words per minute. The towers on the top of which the semaphores were erected were often 50 to 60 feet high, and were placed on eminences about six or eight miles apart. In Russia alone there was a string of these towers from the Prussian frontier to St. Petersburg, a distance of 1200 miles or more. Then, after the electric wire telegraph, came the electric wireless telegraph, and perhaps even a cursory review of this subject will show that it is not of as recent origin as it is popularly thought to be. For instance, it is known that over one hundred and fifty years ago electric signals were sent without wires across lakes and rivers. Dr. Watson, Bishop of Landorff, then sent electric shocks across the Thames, and, subsequently, through the New River at Newington. Similar experiments were made by Franklin in 1748 across the Schuylkill at Philadelphia, and by Du Luc, a year later, across the Lake of Geneva. In these instances, however, the water or earth was the conductor of the electric impulses.

It is fairly well known also that during the past fifteen or eighteen years there have been in limited use a number of wireless telegraph systems which have sometimes been termed induction telegraph systems, and in which electro-magnetic impulses, or waves, are employed. Such systems are based upon the phenomena of mutual induction between wires, discovered by Faraday and Henry. Henry's experiments, made half a century ago, were chiefly with flat coils of wire, one opposite the other. When the circuit of one of such coils, containing a battery, was opened and closed, it was found that an electric current was set up in the other coil. This action also takes place between two straight, parallel wires, and when these parallel wires are sufficiently long, and the electromotive force in the transmitting wire is powerful enough, signals may be received in a telephone or other sensitive receiver, even when the wires are separated a distance of several miles.

In 1892 Sir William H. Preece succeeded in transmitting Morse sig-

nals by this method to a distance of more than three miles, between Penarth, on the mainland, and the island of Flat Holm, in the British Channel, using a telephone as the receiver. More recently the same experimenter has met with success in establishing a wireless telephone circuit by means of which speech is transmitted between the Skerries lightship and the mainland of Anglesey—a distance of nearly three miles—the parallel wire on the Skerries Islands being 750 yards in length, and that on the mainland 3.5 miles in length, the ends of each wire terminating in the sea. On these systems both magnetic induction and electric conduction through the earth and water are utilized.

Remarkable as these results are, however, they have been almost totally overshadowed by those wireless telegraph systems in which electric waves, or ether waves, are utilized, and of which the Marconi wireless telegraph system is the best known. It is of this latter system, as representing, so far as the writer is aware, the most advanced development of this art, that the present article will briefly treat. It would obviously be far beyond the scope of a necessarily limited account to deal with all the wireless telegraph inventions that have been announced within the past few years.

When, in 1864, Clerk-Maxwell, who was, perhaps, the most noted mathematician of his day, made announcement of his celebrated electromagnetic theory of light, which theory involved the existence of electric waves in free space, many of the prominent physicists of the time set themselves the task of demonstrating by experiment the truth of this theory. It was not, however, until 1887 that the actual existence of electric waves in free space was demonstrated, the great honor of this accomplishment falling to Prof. H. Hertz, after whom such electric waves are now almost generally termed "Hertzian" waves. The old popular idea of electricity hardly conceived it as existing outside of a wire or other metallic conductor. The air was an insulator, and how, therefore, could electricity exist apart from a wire! Maxwell overturned this view, and told us that just as under the undulatory theory of light that which we call light is a result of ether vibration, so also is electricity a result of ether vibration, and that, in so far as light and electricity differ, it is only a question of the rate of vibration of the ether, those undulations of the ether which the eye recognizes as light occurring at a rate varying from 400,000,000,000,000 to 700,000,000,000,000 per second, while the frequency of the electric undulations of the ether vary from a few hundreds or thousands to 200,000,000,000,000 per second.

According to the undulatory theory of light, the undulations of the ether, of the frequency just mentioned, are set up by any source of light. Similarly, according to Maxwell's theory, undulations are set up in the ether by any source of electric oscillations, analogously, for example, as waves are set up in the atmosphere by a source of sound. Also, as those ether waves which correspond in frequency to light affect an organ of sight when they fall upon it, and as sound waves affect an organ of hearing when they fall upon it, so, it was reasoned, should the electric waves of the ether affect a suitable electric "eye," or receiver, when they fall upon it.

The manner in which Prof. Hertz proceeded to show the existence of electric waves in free space was, briefly, as follows: It was already known that electric oscillations could be set up in a well-insulated wire or conductor; in fact, that the discharge of the Leyden jar is made up of

a series of electric oscillations, as had been shown by Lord Kelvin in 1853. Hertz set up electric oscillations by means of an electric oscillator, shown in Fig. 1. This consists of an ordinary large induction coil, *A*, the terminals of the secondary coil being connected to small brass balls, or knobs, and to which short metal rods, or wings, *w*, are attached. The knobs are separated by a small air space across which sparks jump when the coil is in operation. At such times electric oscillations are set up, the rate of which varies with the electrical dimensions of the circuit.

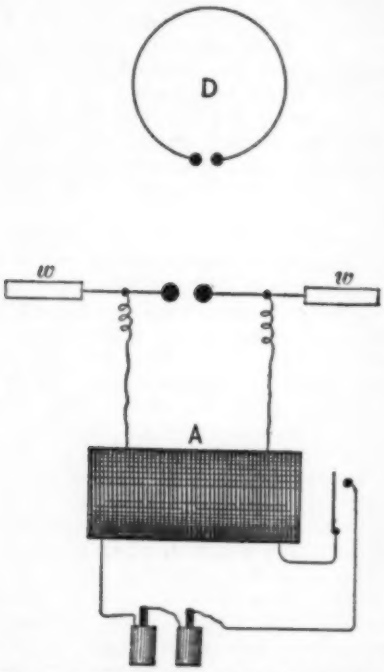


FIG. 1.—An Oscillator and a Hertz Detector.

Hertz assumed that if the electric oscillations thus produced set up corresponding waves in the ether of free space, these waves should, in turn, set up electric oscillations of corresponding frequency in a suitable receiver, or "eye," within the range of their influence. He, therefore, adopted as a receiver of these waves, a copper wire, *D* (Fig. 1), of nearly circular shape, about 16 inches in diameter, but broken at one point. On the ends of this wire he placed small metal knobs, the distance between which could be easily regulated. This wire was held by an insulated handle, a few feet from the oscillator. With the room darkened, minute sparks were observed passing between the discharge knobs of the receiver; and the results of this simple experiment have been generally accepted as proof of the existence of electric waves in free space.

Hertz, however, was not satisfied with this demonstration of the accuracy of Maxwell's theory, but also, in the course of his subsequent masterly experiments, showed that, like sound, heat, and light waves, the Hertzian waves could also be reflected, refracted, concentrated in parallel rays, and to a focus, etc.

By the Hertz receiver the distance at which electric waves could be detected was very limited, perhaps ten or twelve feet at most, and, hence it is not likely that much would have been done in the utilization of Hertzian waves for telegraphic purposes had progress rested there. Fortunately, it did not. Shortly after the experiments of Hertz, Dr. Branly discovered that loose metal filings, which in a normal state have a very high electrical resistance, lose this resistance in the presence of electric oscillations and become practically conductors of electricity. This he showed by placing metal filings in a glass tube and making them part of an ordinary electric circuit (see Fig. 2). When electric waves are set up in the neighborhood of this circuit, electromotive forces are generated in it which appear to bring the filings more closely together, that is, to cohere, and thus their electrical resistance decreases, from

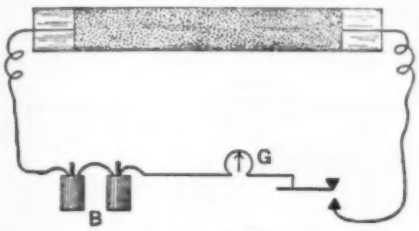


FIG. 2.—A Branly Coherer.

which cause this piece of apparatus—the tube and its filings—is termed a "coherer." Hence, the receiving instrument, *G*, in the figure, which may be a galvanometer or a telegraph relay, that normally would not manifest any sign of current from the small battery, *B*, will be operated when electric oscillations are set up. Prof. Branly further found that when the filings had once cohered they retained their low electrical resistance until shaken apart, for instance, by tapping on the tube.

In 1894 Dr. O. J. Lodge showed that the Branly coherer could be employed to transmit telegraphic signals, and in order that the filings might not remain "cohered" after the cessation of the electric oscillations, he devised a mechanical "tapper," on the principle of the common electric door-bell, the hammer of which was caused to tap the glass tube as long as the electric oscillations continued (Fig. 3).

The filings thus virtually take the place of a key in the ordinary telegraph circuit. In the normal state the key is open; in the presence of electric oscillations the key is closed. Thus, by opening and closing the key for a longer or shorter period, signals corresponding to dots and dashes may be produced. In other words, by setting up electric oscillations for periods of time corresponding to dots and dashes, messages may be transmitted, and if at the receiving station a recording instrument (controlled by the coherer), such as is used, for instance, in the Wheatstone automatic telegraph system, be provided, a record of the message

in dots and dashes is obtained. And this, in short, is what is done in wireless telegraphy.

In 1895-96 Poppoff and others utilized the coherer to show the existence of atmospheric electricity, using for the purpose a vertical wire connected to the coherer, as shown in Fig. 3.

While Dr. Lodge has since done important work in connection with wireless telegraphy, he was, at the time mentioned, presumably more absorbed in the subject from the purely scientific standpoint than otherwise, and although he then, in 1894, intimated that signals might be transmitted to a distance of half a mile, by Hertzian waves, it was not until Marconi began his memorable work that really practical results were obtained.

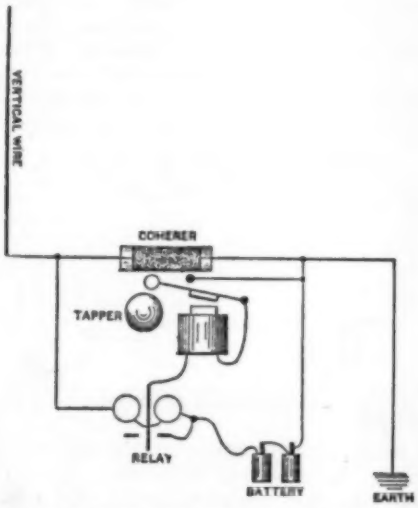


FIG. 3.—Lodge Tapper and Poppoff Vertical Wire Added.

In the operation of his wireless telegraph system Marconi uses an electric oscillator (Figs. 4 and 5), the Branly coherer *k*, the Lodge tapper *t*, in a local circuit, and the Poppoff vertical wire *A*, at the sending and receiving stations, all of which devices, as has been shown, were well known, and it, therefore, has been by modifying, improving, and perfecting these devices, and by adding others, that Marconi has been enabled to obtain his excellent practical results. The improvements and additions that have, perhaps, conduced more than anything else to the first successful results obtained by Marconi were those that related to the coherer and the vertical wire. The sensitiveness of the coherer he increased greatly by diminishing its size, compared with the Branly coherer, and by employing a mixture of nickel filings and silver—90 per cent of the former and 10 per cent of the latter metal. He also placed the few filings used in a vacuum. The other instruments, shown in Fig. 5, are the relay, *R*, controlled by the coherer, and an ink-recording instrument, *E*, controlled by the relay. This figure illustrates the earlier arrangement of Marconi's devices. In it the coherer is directly con-

nected with the lower end of the vertical wire by one of its terminals, and with the earth by its other terminal.

Beginning his experiments in Italy in 1895 with vertical wires 20 feet in height, Marconi found that he could get signals at a distance of one mile, and that by doubling the height of the vertical wire at both stations signals could be transmitted to four times that distance. Thus, with wires 40 feet high he could signal four miles, and with wires 80 feet high, sixteen miles. Since then Marconi has steadily increased the height of the vertical wires, and also the distance to which signals can be transmitted through free space, until in his latest work the vertical wires consist of four parallel wires, 5 feet apart and 157 feet high, and the distance to which signals are transmitted is 186 miles.

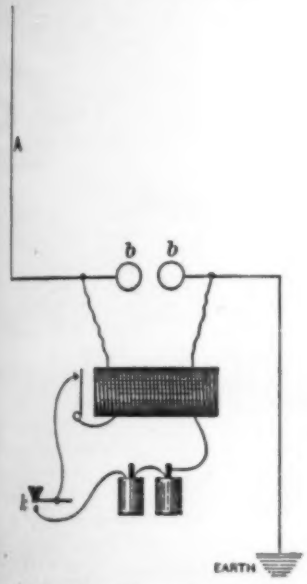


FIG. 4.—Details of Marconi's Transmitting System.

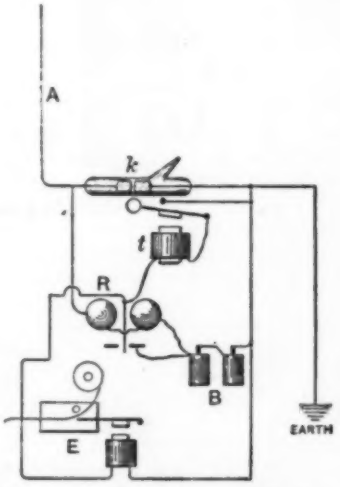


FIG. 5.—Outline of Marconi's Earlier Devices.

The amount of electrical energy employed in setting up the electric oscillations for this present maximum distance of 186 miles is about 130 watts (10 volts and 15 ampères), or about one-fifth of a mechanical horsepower. The source of the electrical energy is a storage battery, which latter is usually charged by a large number of dry cells. In passing, it may be remarked that an ordinary telegraph relay may be operated at a distance of 186 miles at an expenditure of three watts at the transmitting end of a telegraph wire, or with one-fiftieth of the energy used in operating the electric oscillator in question. The actual energy required to operate the telegraph relay is about 0.24 of a watt, the rest of the energy being consumed in the wire itself. It must not, however, be assumed from this that the coherer is a less sensitive electric receiver than the relay; nor will it be, when it is reflected that the electrical

energy expended in the case of the relay is, so to speak, mainly confined to the wire, as, analogously, sound waves are confined within a speaking-tube, whereas the electrical energy of the oscillator is radiated into space in every direction, and thus but a small portion of the total energy reaches the receiving vertical wire. It has been calculated that the electrical energy received on a surface 1 foot square at a distance of but one mile from the oscillator is less than one-three-hundredth-millionth of the total energy radiated, and it may be noted, the energy actually radiated as electric waves is a mere fraction of the energy consumed in and at the oscillator.

From the results obtained by Marconi and others, it appears that the effect of increasing the length of the vertical wires is to give a greater

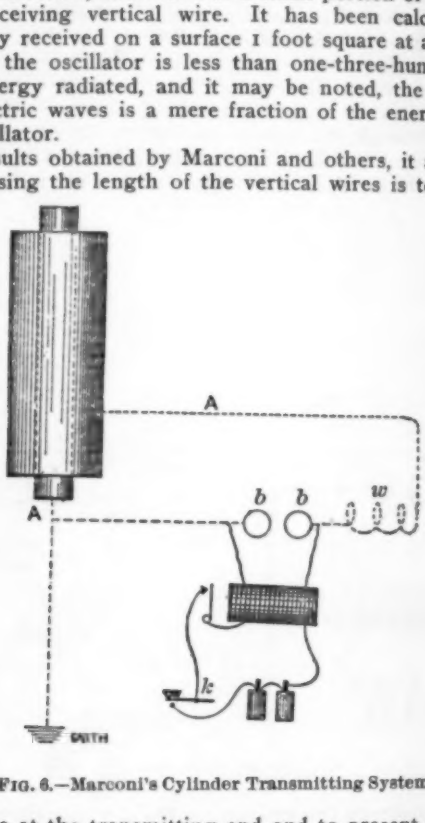


FIG. 6.—Marconi's Cylinder Transmitting System.

radiating surface at the transmitting end and to present at the receiving end a larger surface upon which a greater number of circles of waves may fall, each circle of waves adding to the electrical energy set up in the receiving vertical wire. This view is seemingly borne out by the more recent results obtained by Marconi with a metal cylinder, 4.1 feet high and 1.3 feet in diameter, with which arrangement signals have been transmitted over thirty-one miles. (Fig. 6.)

The vertical wire is usually of stranded copper, about ¼ inch in diameter, although Marconi for this purpose uses also strips of wire netting, about 2 feet broad. The wire or netting is supported by masts of proper height, securely guyed. It is not necessary that the wire be suspended strictly vertically so long as the desired vertical height is obtained. The wire is thoroughly insulated from the mast at the top by sticks of rubber or ebonite, and is led in through an open window or hatchway to the room where the transmitting and receiving apparatus are situ-

ated. Although the discharge knobs are separated by an air space of only about half an inch, the induction coil used in connection with the oscillator is often capable of producing a spark that will jump ten or twelve inches through air. The actual appearance of the induction coil, discharge knobs, vertical wire, etc., is well illustrated on the page opposite. The heavy current and high pressures in the circuits of the oscillator have led to the adoption of a much larger key for manipulating the oscillator than is used in ordinary Morse telegraphy.

At an early period of the practical history of Hertzian wave telegraphy it was seen that the usefulness of this art might be considerably curtailed by the fact that but one message could be transmitted between any two stations within the sphere or "radius" of influence of a transmitter, since the attempt to transmit even two messages at one time would result in an unintelligible mixture of both messages. Several inventors have been more recently at work trying to overcome this defect, and, it is claimed, with success, notably Dr. Lodge, Sig. Marconi and Dr. Slaby. The plan followed by these gentlemen has been that of employing a syntonic or tuning method; that is, the transmitting and receiving circuits are adjusted or "attuned" to a given rate of electrical oscillations.

It is a well-known experiment that when two tuning-forks, having an identical fundamental rate of vibrations, are placed in suitable proximity, either fork may be set into vibration by air waves set up by the other fork, and neither will be set into vibration by another fork of a different note. The tuning-fork is a persistent vibrator by virtue of two qualities which it possesses, elasticity and inertia. When struck a smart blow, it moves from its point of rest; directly its elasticity returns it to its point of rest, its inertia carries it past that point, its elasticity returns it to zero point, inertia carries it past, and so on, until the resistance of the air and other causes stop it. Analogously, an electrical circuit may be given, in almost any desired proportion, the equivalents of mechanical inertia, elasticity and resistance, in inductance, capacity, and ohmic resistance, respectively; and the rate of electric oscillation of a circuit may be varied by varying these factors—the smaller the factors, the higher the rate of oscillation.

When, then, the receiving circuit of a wireless telegraph system is accurately tuned to oscillate in harmony with the transmitting circuit, which can be done by giving the respective circuits practically equal inductance, capacity, and resistance, the receiving circuit will respond only to the oscillations set up by a transmitter correspondingly tuned. At least, this is, briefly, the theory on which these experiments are based. In experimenting, Marconi and others have, it is stated, found that perfect syntony between the respective stations is not absolutely essential, but that if there is a marked divergence of frequency of oscillation between them, the receivers will not respond to any but their correspondingly attuned transmitter.

The arrangement of Marconi's tuned transmitting and receiving circuits is outlined in Figs. 7 and 8. It will there be seen that the oscillator and the coherer *k* are not connected to the earth, as in Marconi's first experiments, but are kept in electrical connection therewith by a small induction coil *T*. In Fig. 7, *A* is the vertical wire, which is attached at its lower end to a coil of wire, *w*. The end of the wire *d*, which forms a part of the secondary wire of the induction coil, *T*, may be connected

to any desired turn of the coil *w*. By this means the inductance of the vertical wire circuit may be varied, and its oscillation period thereby be made to correspond with that of the circuit *B*, of the oscillator, which includes the primary wire of *T*; *C* is an adjustable condenser of very small capacity, by varying which the oscillation period of the circuit may readily be varied. An electrical condenser is virtually a Leyden jar, arranged in a convenient form. In this case it consists of a few sheets of tinfoil or copper, the alternate sheets being separated from each other by thin sheets of paraffin paper. A key controls the storage battery circuit, as shown in Fig. 7, and, thereby, the oscillator circuit; *M* is the induction coil of the oscillator.

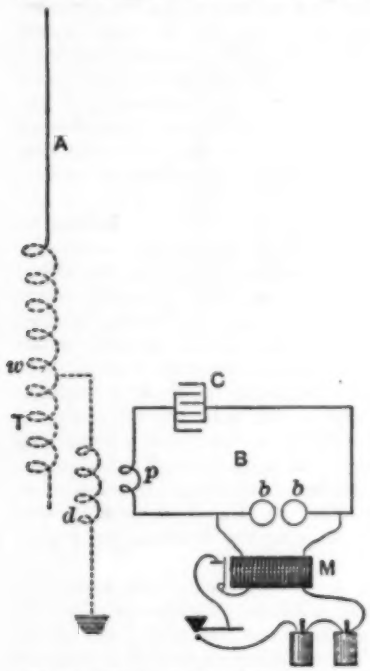


FIG. 7.—Marconi's Tuned Transmitting Circuit.

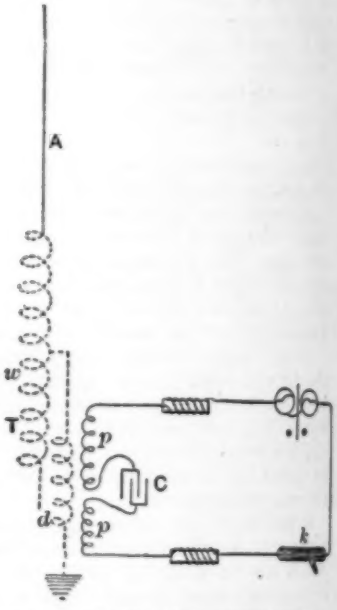


FIG. 8.—The Tuned Receiving Circuit.

The tuned receiving apparatus is shown in Fig. 8. In this figure, *A* is again the vertical wire with the turns of wire, *w*, to which is attached the primary wire *d* of the induction coil *T*; *p* is the secondary of the same induction coil; *k* is the coherer, and *C* is a condenser. The induction coil *T* acts virtually as a step-up transformer, which, it is claimed, materially enhances the electromotive forces of the received oscillations, and thus increases the signalling distance.

Marconi has found it important that the oscillation period of the coherer circuit, shown in the figure in solid lines, shall be the same as, or an octave of, the oscillation period of the vertical wire circuit, shown by the dotted lines. This can be done by making the secondary coil *p*,

of the coil *T*, equal the length of the vertical wire *A*. The transmitter circuit is then adjusted so that its oscillation period corresponds with that of the receiving circuit. This is brought about by varying the capacity of the condenser in Fig. 7. The method of obtaining this "balance," as practiced by Marconi, is to begin with very little capacity in the condenser, and adding to it until the best results are obtained at the receiving station. If, when the best results are obtained still further capacity is given to the condenser in the transmitting circuit, the signals fade away, showing that then the two circuits are out of harmony.

Marconi also found that by means of tuned apparatus a much greater distance may be reached, with a given source of electrical energy and height of wires. For example, a transmitter which would affect a tuned receiver thirty miles away, would not affect a non-tuned receiver 160 feet distant. This, it may be assumed, is because in the case of the tuned receiver the faintest oscillations, or electromotive forces, set up in the receiving circuit by the incoming waves, are in unison with those waves, and successive incoming waves amplify the oscillations in the receiver circuit until they affect the coherer; whereas the oscillations which the same waves tend to set up in the non-tuned receiver circuit are, so to speak, out of step with the natural rate of oscillation of the non-tuned circuit, and thus as frequently oppose as assist the natural oscillations of the circuit.

In connection with the experiments carried on by Marconi, it is reported that two different messages have been received at one time on a vertical wire, two sets of receiving apparatus, each attuned to a different rate of oscillation, being connected with the same wire. To those who have had experience with Gray's harmonic system of wire telegraphy, in which three and four instruments, attuned to transmit and to receive different rates of electrical current pulsations, have been successfully and separately operated on one wire, this will not appear astonishing, since it is quite conceivable, if it be granted that wireless transmitting and receiving apparatus can be successfully attuned, that two or more receiving instruments might be connected with one vertical wire, and each set of apparatus select and respond only to the particular rate of oscillations to which it is attuned.

However, while the successful operation of contiguous, tuned circuits is quite within the possibilities, it is to be noted that on the occasion of the recent international yacht races, in the United States, off Sandy Hook, when three different sets of wireless telegraph apparatus were in readiness to report the progress of the races, including one set sent out by the Marconi Company, and presumably equipped with tuned apparatus, interference between the different sets of apparatus was pronounced. From France also it is reported, as the results of numerous tests, that freedom from interference with tuned apparatus is not yet secured. But if by the use of tuned apparatus nothing else were gained than the ability with a given amount of electrical energy and a given height of vertical wire, to transmit signals to a greater distance than is possible with untuned apparatus, it must be considered a decided advance in the art, and judging by the whole progress of electrical telegraphy, it is safe to say, when so much has already been achieved, that the necessary improvements to obtain at least practical freedom from interference between adjacent apparatus will ultimately follow.

The specimen of a dot and dash wireless telegraph record given in Fig. 9 is a facsimile of bulletins "caught on the wing" during the yacht races of 1899 in New York Harbor. Mr. Marconi had his apparatus on the steamship Ponce, and was sending bulletins of the progress of the race to the Mackey-Bennett cable ship, some miles away, when this specimen and many others were recorded by a set of Clarke wireless telegraph apparatus which the writer was supervising on the steamship Le Grande Duchesse. This was probably the first instance of tapping Hertzian wave signals, in the United States at least. It will be understood that Shr. is an abbreviation of Shamrock. Other abbreviations were used in these bulletins, as Col. for Columbia; abt. for about; bd. for board, etc. The present speed of signalling by wireless telegraphy is from ten to twenty words per minute; but it seems reasonable to expect that expert manipulators of the key should eventually attain a considerably higher speed by this system.

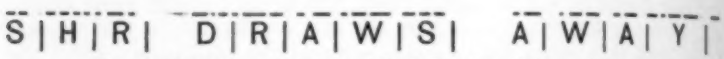


FIG. 9.—Specimen of a Dot and Dash Wireless Telegraph Record.

For practical purposes there is not much doubt that wireless telegraphy will find its greatest field of usefulness between vessels at sea, or between vessels and the mainland, or between points divided by the sea where it is not deemed feasible or profitable to lay a cable. Numerous examples of such uses of Marconi's wireless telegraph system are already in evidence. There is, for example, a wireless circuit between some of the Sandwich Islands; another between the Lizard, Cornwall, and St. Catherines, Isle of Wight, 186 miles apart, and between Poole and St. Catherines, 31 miles apart. The British Admiralty have also adopted the system for many of their warships and for some of their land stations. In all, they have about forty sets of such wireless telegraph apparatus installed. The length of vertical wire of these stations is about 150 feet. The warships thus equipped have signalled each other when 100 miles apart. The wireless system is also installed at different points on the Continents of Europe and America—at La Panne, Belgium, for example, and at Borkum Island, in the North Sea, off the mouth of the Ems.

A number of lightships have also been equipped with the Marconi system; the Goodwin Sands lightship, at the Borkum lightship, twenty-five miles from the island of that name, and the Nantucket lightship, off the Massachusetts coast, from which station passing vessels are daily reported to the mainland.

Many mercantile steamships have also been equipped with the same system, notably the Kaiser Wilhelm der Grosse, of the North German Lloyd Steamship Company, the Deutschland, of the Hamburg-American Line, and the vessels of the Cunard Line. Recently the Etruria and Umbria, of the last-mentioned line, communicated by wireless telegraphy in mid-ocean, and while out of sight of each other, communication being thus kept up for about three hours while the vessels were passing in opposite directions.

There is little doubt that the use of wireless telegraph systems by the navies of the world will become general in the near future. There are several reasons why such systems are especially applicable to, and de-

sirable on, war vessels, which depend so largely on signalling. For instance, signalling by the Hertzian waves is more successful over water than over land, greater distances being reached over water. The vessels already carry the necessary masts for the vertical wires; the apparatus, including batteries, does not require to be portable; there is at present no other practicable method of signalling at sea to a distance of even a few miles in foggy or hazy weather.

With regard to the use of wireless telegraphy for military purposes in actual warfare, the problem is somewhat different, and the obstacles to its use are considerable. Thus, the question of obtaining and transporting the masts for the vertical wires is a serious one. This was one of the difficulties met with in the South African war. The matter of providing in an easily portable and reliable form the electrical energy required for the operation of the oscillator is also likely to be rather difficult under some circumstances. Should the cylinder lately employed by Marconi be found suitable for land work, this would be a decided gain, and if by this means a reasonable distance, say, fifteen to fifty miles, could be reached by wireless telegraphy, it would be a very valuable addition to military signalling in the field.

There is, however, nearly always in land operations the alternative of wire telegraphy, and while the difficulties of transporting the poles and wires for such systems are frequently very great, they have rarely been found insurmountable, and where such may be the case, as when an enemy is between a relieving army and a beleaguered garrison, it is very probable that the enemy, by keeping up a "crossfire" of electric waves, could prevent communication, by means of wireless telegraphy, with the beleaguered army.

As to the commercial or monetary value of wireless telegraphy, it is yet too early to comment. It is understood that the Marconi Company receives from the British Admiralty £100 per annum, for fifteen years, presumably during the life of patents, for each station equipped. The Borkum lightship is what may be termed a wireless telegraph "pay station," and according to the German postal authorities, which control this station, 565 messages were handled during five and a half months, or about three messages per day, of which 518 messages came from ships at sea, while 47 were transmitted to ships. A large percentage of these messages were to and from North German Lloyd steamers.

Since the first announcement of Marconi's successes with wireless telegraphy many aspirants for honors in the same field have naturally arisen, but so far as actual commercial results are concerned, Marconi has seemingly kept well ahead of other workers along this line, many of whom—but with notable exceptions, like Messrs. Lodge, Slaby, Guarini, and some others—while making promises of great prospective results, have deemed it wise to give only the most meager technical information concerning their devices, on the ground of the unprotected condition of their inventions in the patent office. Indeed, Marconi has also frankly admitted that considerations of this nature have frequently prevented earlier public notice of his improvements in the art which, with the able scientific and financial aid at his command, he may be said to have virtually made his own; but, on the whole, this gifted experimentalist has been so liberal in the quantity and quality of information which he has imparted concerning his improvements that if occasionally he acts upon the advice of Robert Burns to a young friend, "'Aye keep some-

thing to yoursel' you never tell to ony," it is certainly his privilege so to do.

To obtain the greatest degree of usefulness from wireless telegraphy, when it is employed to prevent collisions at sea, and to send information from vessels in distress, or when approaching or departing from their respective harbors, which are popularly supposed to be the functions for which this system is especially adapted, it would appear to be essential that every vessel sailing the main should be equipped with the apparatus. The writer can say from experience that it requires a considerable degree of expertness to maintain the apparatus in proper working order, and even when code signals only are employed, a fair amount of intelligence is required. It is, therefore, a question whether the requisite skill and intelligence would be available at all times on all kinds of craft.

There are, however, doubtless a great many places where the necessary expertness of operators is available, and in which, therefore, the full value of the system will be realized. In fact, it may be stated that a vastly larger employment of wireless telegraphy is already assured, since, quite recently, the Lloyds, whose extensive maritime interests are world-wide, have entered into a contract with the Marconi International Marine Communication Company to equip all their coastwise signalling stations with this system, and to transmit and receive messages to and from all passing vessels similarly equipped, at a regular tariff rate of about twelve cents per word, this agreement to extend over a period of fourteen years. Already in the comparatively few instances where the system has been introduced its great utility and importance have been amply demonstrated.

A number of vessels equipped with wireless telegraph apparatus have signalled for aid for themselves and for other vessels in distress; necessary supplies for lighthouses have by this means been procured in emergencies, and in other ways life and property have already been safeguarded by the aid of this latest wonderful utilization of Nature's greatest mystery, the ether, by the genius of man.

By WILLIAM MAVER, JR., in *Cassier's Magazine.*

BOOK NOTICES.

"The Life of John Ancrum Winslow, Rear-Admiral, United States Navy"* is a most valuable contribution to the naval as well as to the general history of our country. The distinguished author, Lieutenant Ellicott, was well qualified for the authorship of this important work. Experienced in battle and in letters, a student of naval subjects, he has brought to consideration the life services, never fully appreciated by Americans, of Admiral Winslow.

Most of us have known of Winslow only as the commander of the victorious Kearsarge. We now know him as a young officer of signal service during the Mexican War; as the patient, devoted officer of peace times; during the Civil War, previous to his assignment to command the Kearsarge, Winslow was to be found in positions of trust and responsibility, always giving efficient service. His work while in command of the Kearsarge was fittingly crowned by the great victory over the Alabama.

Previous to the engagement off Cherbourg, Winslow had been of greatest service in preventing a number of Confederate cruisers which were in French and English harbors, from getting to sea; and also in influencing the French and British governments to keep, much to their disinclination, within the bounds of neutrality. Winslow's watchfulness, alertness, and all around efficiency, prevented the Confederates from carrying out many well-laid plans, for there was always the Kearsarge to be reckoned with. Winslow was at last appreciated by his government which evinced its great confidence in him by appointing him to a flag command of greatest importance.

The correspondence of Admiral Winslow has been preserved, and by these letters Admiral Winslow tells his life story, assisted by supplementary remarks from Lieut. Ellicott which tend to make this a most readable book. Winslow's life record is that of the faithful, persevering, devoted and able officer, and of the lovable, honorable man.

There is much in the book bearing upon the Mexican War, and upon the actions taken by England and France with regard to Federal and Confederate ships, that is brought out for the first time; this is a valuable contribution to history.

We sincerely congratulate Lieut. Ellicott upon his description of the engagement between the Kearsarge and Alabama. It is admirable. We do not know of any account, judging from the naval, historical or literary standpoint that is as good. But there are many students of Paul Jones' career who will dissent from Lieut. Ellicott's conclusions that this "is the most memorable naval duel yet chronicled in the world's history."

We have received from the publisher, John Murray, London, "Notes on Fortification," by Major B. R. Ward, R. E. of the Royal Military

*The Life of John Ancrum Winslow, Rear Admiral, United States Navy, by John M. Ellicott, Lieut. U. S. Navy, published by G. P. Putnam's Sons, New York.

Academy, Woolwich. The book is divided into five sections, as follows:

Section I. Permanent Fortification.
Section II. Sea Power.
Section III. Coast Defence.
Section IV. Submarine Mining.
Section V. Organization of the Corps of Royal Engineers.

A synoptical chart is included. The whole work is comprised in 48 pages, evidently boiled down from as many volumes. The publisher's price is 5 shillings, net.

The author has presented in few pages a most important work. It will recommend itself to all students of this important subject as one of the most useful contributions to the science of fortifications. Its great value is that there is so much in so little space, saving one enormous labor of consulting many volumes. We believe that this work will be much appreciated throughout the military and naval services of the United States.

We have received from the publishers, Messrs. E. Bernard and Co., a copy of "Les Chaudieres Marines," * by Monsieur L. E. Berton, Director of French Naval Construction. We have read this work with the greatest of interest, and recommend it to all who are interested in boilers; in their design, building, care, and handling; adequate attention is given to the subject of boiler fittings. There are 549 pages to this work, subdivided into 19 chapters, and 300 illustrations. The work is a study of all kinds of boilers in present use, by a man who understands his subject. The illustrations are really working drawings, and the text is as clear as the illustrations. M. Berton has devoted much attention to the various water-tube boilers of American design, without neglecting those of other countries; it is this feature that makes the work especially valuable; for the work is as valuable to the American student as to the French student.

The nineteen chapters are divided into four parts, with an introduction.

The introduction is a clear, though concise account of the principles of Marine Engineering, and the use of boilers and machinery.

The first part discusses the manipulation and handling of boilers; the different fuels in use; forced draft.

The second part discusses fire tubular boilers, and locomotive boilers, care, handling, and repair.

The third part discusses with great completeness, water tubular boilers, of all types.

The fourth part discusses in all details the accessories of boilers.

We again repeat that we recommend this work as most valuable to all interested in the subject of boilers.*

The "Trumpeter's Hand-Book and Instructor," by William S. Littleton, published by The Hudson-Kimberley Publishing Co., by authority of the Secretary of War, will prove valuable to the musician who desires to become a proficient performer on the trumpet. It furnishes a simple and easy method for self instruction. The volume is small and compact and contains the various calls pertaining to the several branches of the service. The book is well adapted for use in the Army and National Guard.

*Les Chaudieres Marines, by L. E. Breton, Director French Naval Construction. 25 Francs. Published by E. Bernard & Co., 29 Quai Des Grands Augustins, Paris.

OBITUARY.

WILLIAM THOMAS SAMPSON.

The service needs no notice of the death of a great leader like Rear-Admiral William T. Sampson, but the Naval Institute honors itself in recording something of the services of its late President.

As in all matters of importance to the Navy since the Civil War, Sampson's guiding hand was felt in the affairs of the Naval Institute. He was a contributor, a member of the Board of Control, Vice-President, and at the time of his death, President of the Institute.

From the beginning of his career to the end, Sampson took a leading place among his contemporaries, and has left his mark on every undertaking. He graduated from the Naval Academy at the head of his class. He was an instructor there, afterwards twice Head of Department, and finally Superintendent. He was also in command of the Torpedo Station at Newport, R. I., and no one has had more than he to do with the education of the officers of the navy.

In the building up of the new navy Sampson took a leading place. While on the various boards of which he was a member types of ships were recommended. While at the Torpedo Station, at the Gun Factory, Washington, and while Chief of Bureau of Ordnance and Gunnery, he helped to place us abreast if not ahead of all maritime nations in ordnance and armor. As a member of the Board on Construction while a Chief of Bureau, he had a directing hand in the designs of many of our vessels of war.

His services were frequently required in the councils of the country to determine our Naval Policy. He was one of the naval members of the Board on Fortifications, a member of the Naval Policy Board, a member of the International Prime Meridian Council, and a delegate to the International Maritime Conference. On every board and in every council he took a prominent part.

Sampson was more than a student; he was a thorough seaman. To excellent judicial powers he joined great executive ability. Ready to weigh the reasoning on both sides of a question, he could decide quickly and firmly in emergencies. He was executive officer of the Patapsco in 1865 when she was sunk by a mine in Charleston Roads, and was recommended for bravery. In 1871 he was executive of the Congress in

the Mediterranean, and he was a crack Mediterranean executive with all that the phrase meant in those days. He commanded the Swatara on the Asiatic Station and the San Francisco, one of the first of our new navy, on the Pacific Station, and they were noted for order and efficiency. He commanded the Iowa when he was called to take command of the North Atlantic Squadron, and hoisted his flag on the New York.

From his graduation as a Midshipman at the head of his class, to his success as a Commander-in-Chief at Santiago, Sampson easily led his associates. Beyond his intellectual acquirements his courage was his most marked characteristic. Not mere physical courage, common to nearly all American, but that rarer characteristic, mental courage, which excludes fear not only of personal harm but of all the consequences of necessary risks. He knew nothing of fear and never considered the personal effect of any decision. Whether it was danger to himself or to those under his command he never hesitated; but weighing the conditions he decided what was best and never looked backwards.

His crowning opportunity was off Santiago. He forged the material. His hand wielded the weapon and struck the blow; the enemy was crushed. The same calm grave man that stood day and night on the deck of the New York, asking questions, seeking information and issuing necessary orders, received the flags siezed from the burning and sinking Spanish vessels. No exultation, no excitement, he was accustomed to succeed in his undertakings. Who is not proud to say "I served under Sampson." The man is dead, but his works will live while sea power remains an American necessity.

RICHARD WAINWRIGHT.

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SPECIAL NOTICE.

NAVAL INSTITUTE PRIZE ESSAY, 1903.

A prize of one hundred dollars, with a gold medal, is offered by the Naval Institute for the best essay presented on any subject pertaining to the naval profession, subject to the following rules:

1. The award for the prize shall be made by the Board of Control, voting by ballot and without knowledge of the names of the competitors.

2. Each competitor to send his essay in a sealed envelope to the Secretary and Treasurer on or before January 1, 1903. The name of the writer shall not be given in this envelope, but instead thereof a motto. Accompanying the essay a separate sealed envelope will be sent to the Secretary and Treasurer, with the motto on the outside and writer's name and motto inside. This envelope is not to be opened until after the decision of the Board.

3. The successful essay to be published in the Proceedings of the Institute; and the essays of other competitors, receiving honorable mention, to be published also, at the discretion of the Board of Control; and no change shall be made in the text of any competitive essay, published in the Proceedings of the Institute, after it leaves the hands of the Board.

4. If, in the opinion of the Board of Control, the best essay presented is of insufficient merit to be awarded the prize it may receive "Honorable Mention" or such other distinction as the Board may decide.

5. Any essay not having received honorable mention, may be published also, at the discretion of the Board of Control, but only with the consent of the author.

6. The essay is limited to fifty (50) printed pages of the Proceedings of the Institute.

7. All essays submitted must be either type-written or copied in a clear and legible hand.

8. In case no essay is awarded the prize, the writer whose essay is first in order of merit will, if his essay has received honorable mention, be made a life member. Additional recognition of the merits of papers may be made by the Board at its discretion.

9. In the event of the Prize being awarded to the winner of a previous year, a gold clasp, suitably engraved, will be given in lieu of a gold medal.

By direction of the Board of Control.

E. L. BEACH,
Lieut., U. S. N., Secretary and Treasurer.